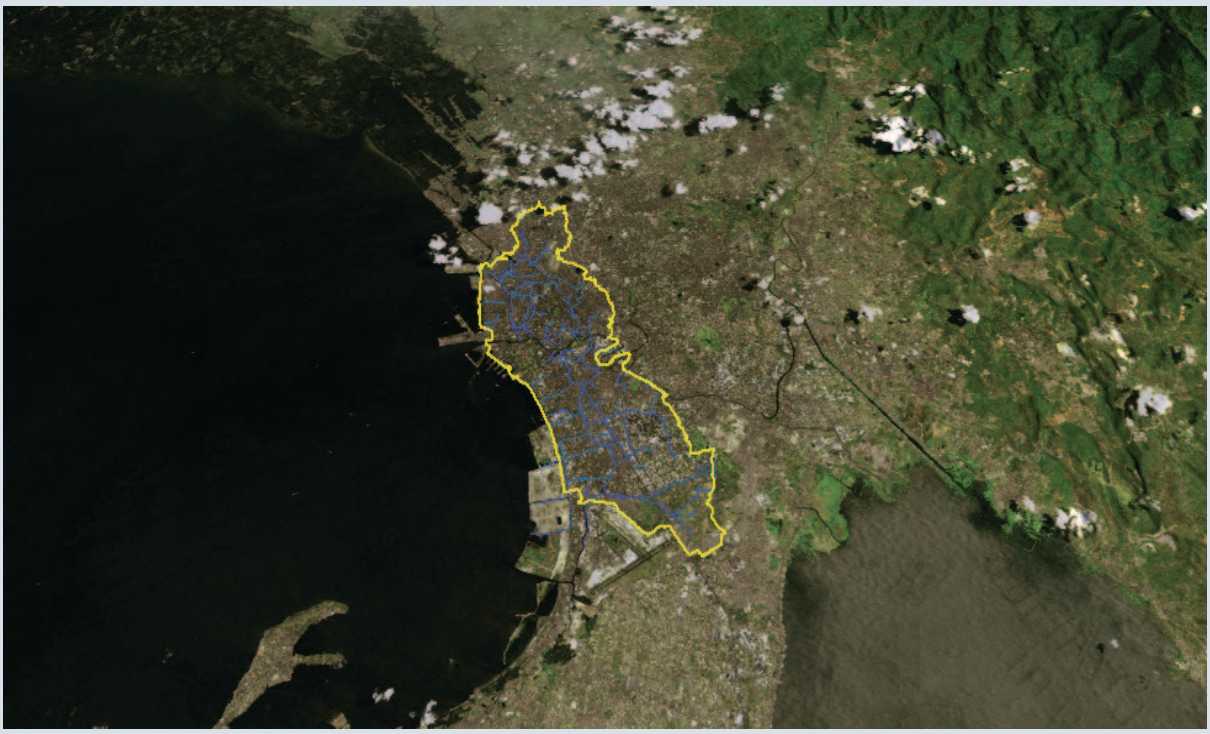
No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

METROPOLITAN MANILA DEVELOPMENT AUTHORITY (MMDA)
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH)
THE REPUBLIC OF THE PHILIPPINES

THE STUDY ON DRAINAGE IMPROVEMENT IN THE CORE AREA OF METROPOLITAN MANILA, REPUBLIC OF THE PHILIPPINES

FINAL REPORT SUMMARY



MARCH 2005

PACIFIC CONSULTANTS INTERNATIONAL
NIKKEN CONSULTANTS, INC

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Foreign Currency Exchange Rates Applied in the Study

Currency	Exchange Rate/USD
Philippine Peso (Php)	55.0
Japanese Yen (JPY)	110.0

(Rate as of July, 2004)

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on Drainage Improvement in the Core Area of Metropolitan Manila, Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Hajime TANAKA of Pacific Consultants International (PCI) and composed of staff member of PCI and NIKKEN Consultants,Inc. to Philippines, three times between February 2004 and March 2005. In addition, JICA set up an advisory committee headed by Mr. Nobuhisa TAKEDA, Japan International Cooperation Agency, between August 2003 and March 2005, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of the Philippines, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

March, 2005

Etsuo Kitahara
Vice-President
Japan International Cooperation Agency

THE STUDY ON DRAINAGE IMPROVEMENT IN THE CORE AREA OF METROPOLITAN MANILA, REPUBLIC OF THE PHILIPPINES

March, 2005

Mr. Etsuo Kitahara
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

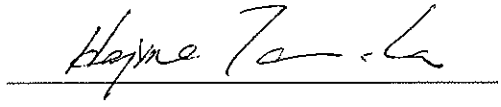
We are pleased to submit you the final report entitled "The Study on Drainage Improvement in the Core Area of Metropolitan Manila, Republic of the Philippines". This report has been prepared by the Study Team in accordance with the contracts signed on 8 August 2003, 30 January 2004 and 16 September 2004 between the Japan International Cooperation Agency and the Joint Study Team of Pacific Consultants International and NIKKEN Consultants,Inc.

The report examines the existing conditions related to drainage in the Core Area of Metropolitan Manila, proposes a master plan for the drainage improvement and presents results of the feasibility study on priority projects identified in the master plan.

The report consists of the Summary, Main Report, Supporting Reports, Data Books (including drawings). The Summary summarizes the results of all studies. The Main Report contains the existing conditions, the proposed master plan, the results of the feasibility study, and conclusions and recommendations. The Supporting Reports include technical details of the Study. The Data Books contain basic data and drawings used in the Study.

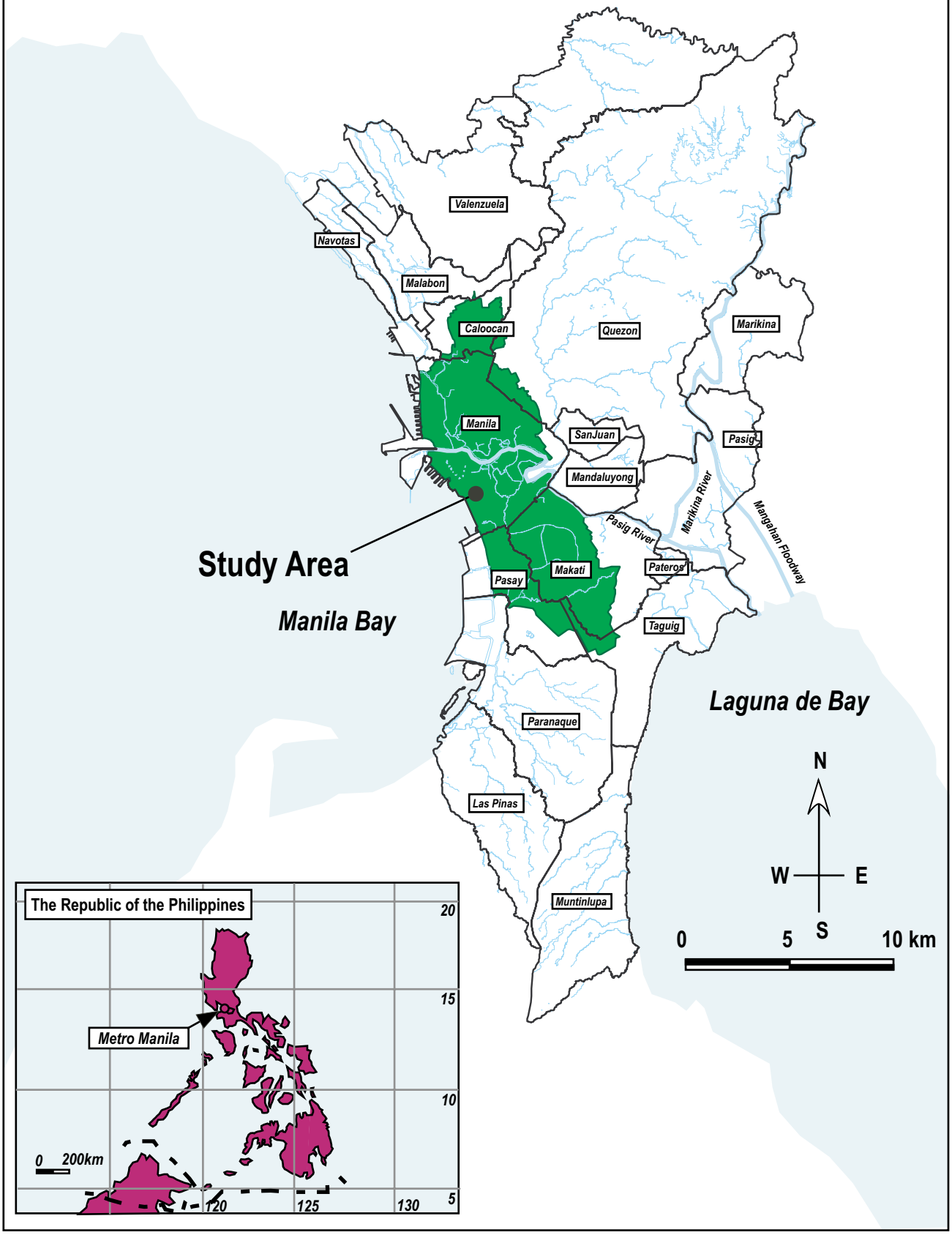
All members of the Study Team wish to express grateful acknowledgement to the Japan International Cooperation Agency (JICA), JICA Advisory Committee, Ministry of Foreign Affairs, Ministry of Land, Infrastructure and Transport, Japan Bank for International Cooperation, Embassy of Japan in the Republic of the Philippines, and other donors, and also to Philippine officials and individuals for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the drainage improvement in the Core Area of Metropolitan Manila, and that friendly relations of both countries will be promoted further by this occasion.

Yours faithfully,

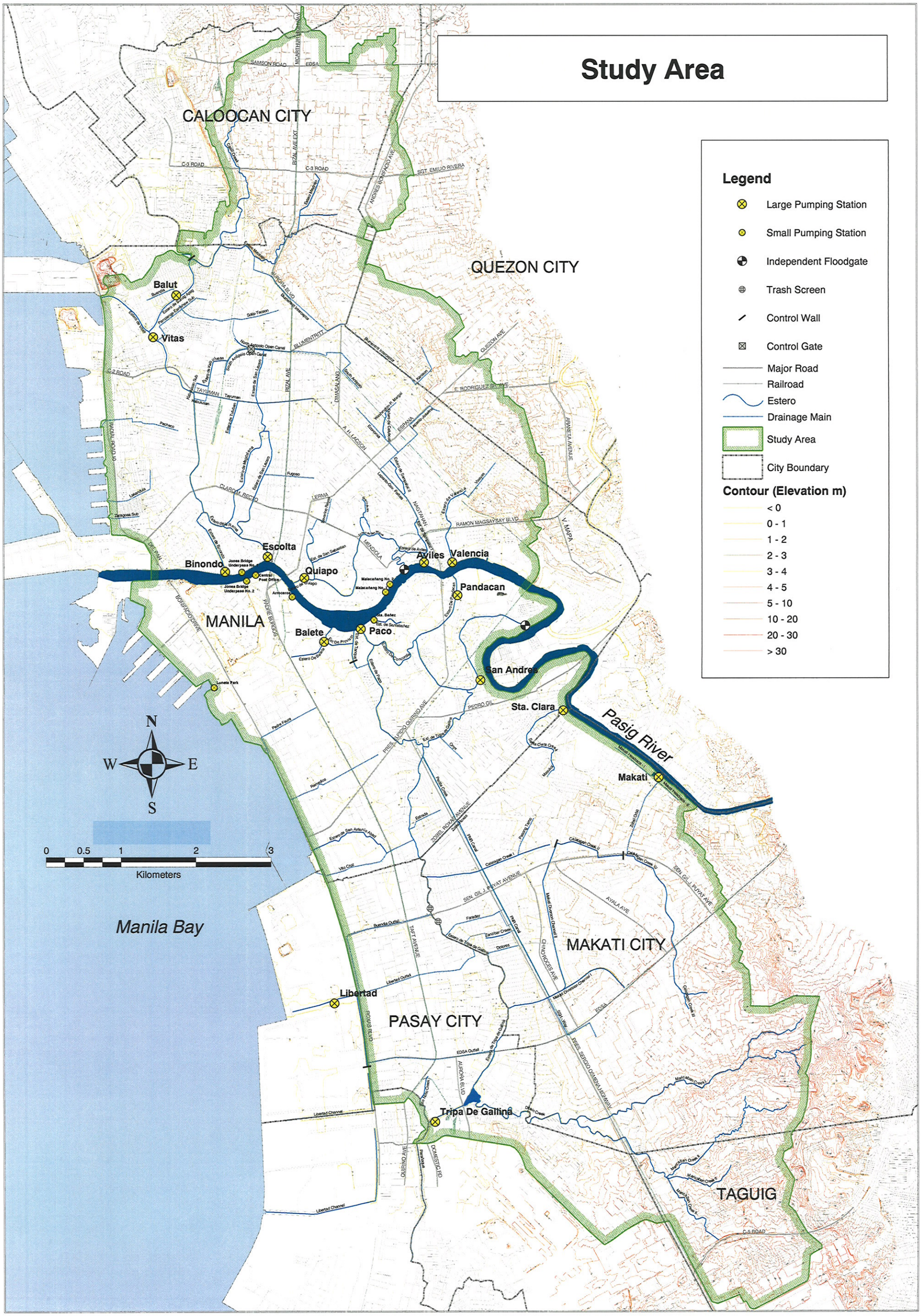


Hajime Tanaka
Team Leader

Study on Drainage Improvement in the Core Area of Metropolitan Manila, Republic of the Philippines



Study Area



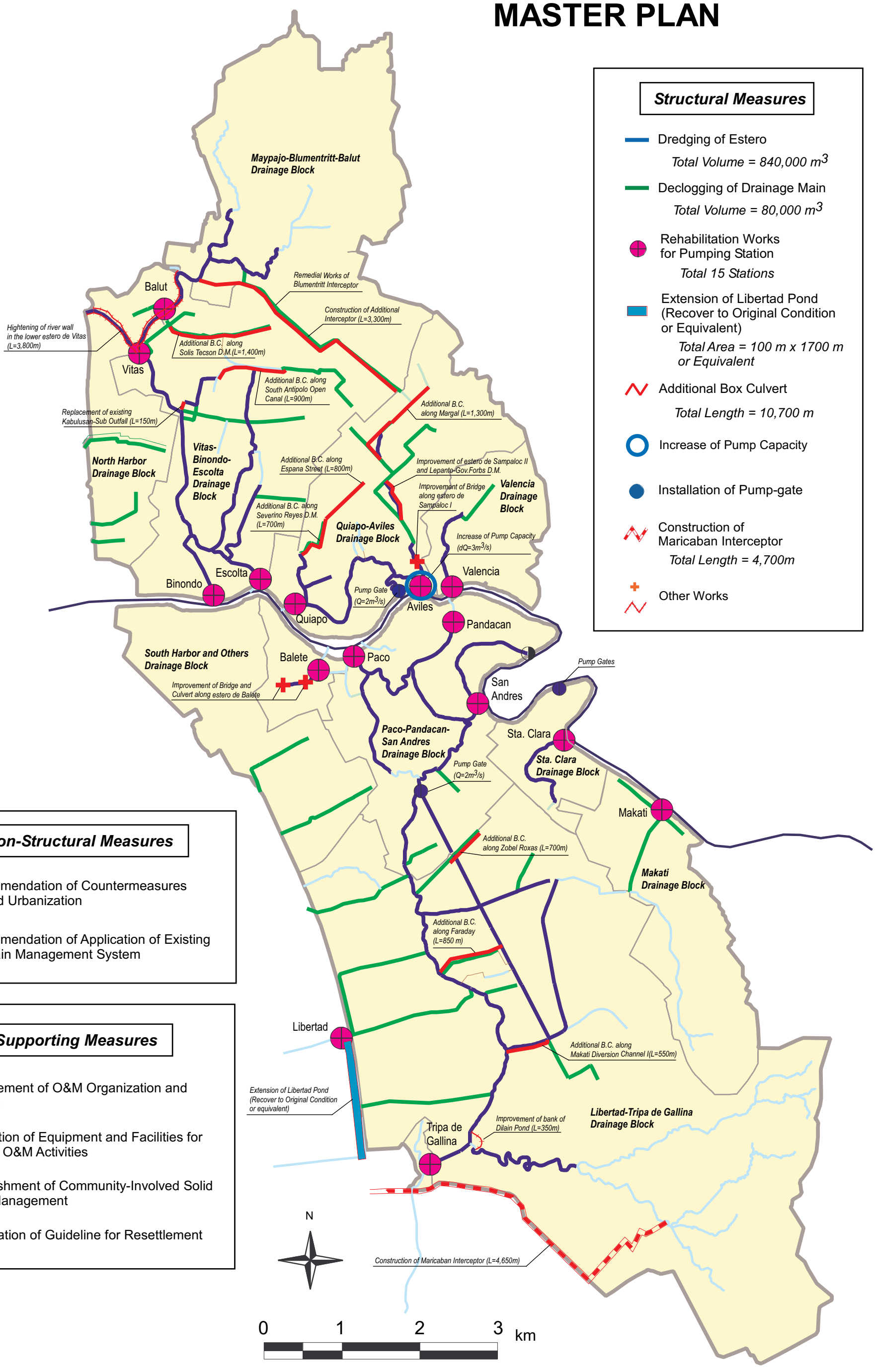
Legend

- Large Pumping Station
- Small Pumping Station
- Independent Floodgate
- Trash Screen
- Control Wall
- Control Gate
- Major Road
- Railroad
- Estero
- Drainage Main
- Study Area
- City Boundary

Contour (Elevation m)

- < 0
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- > 30

MASTER PLAN



Structural Measures

- Dredging of Estero
  Total Volume = 840,000 m^3
- Declogging of Drainage Main
  Total Volume = 80,000 m^3
- Rehabilitation Works for Pumping Station
  Total 15 Stations
- Extension of Libertad Pond (Recover to Original Condition or Equivalent)
  Total Area = 100 m x 1700 m or Equivalent
- Additional Box Culvert
  Total Length = 10,700 m
- Increase of Pump Capacity
- Installation of Pump-gate
- Construction of Maricaban Interceptor
  Total Length = 4,700m
- Other Works

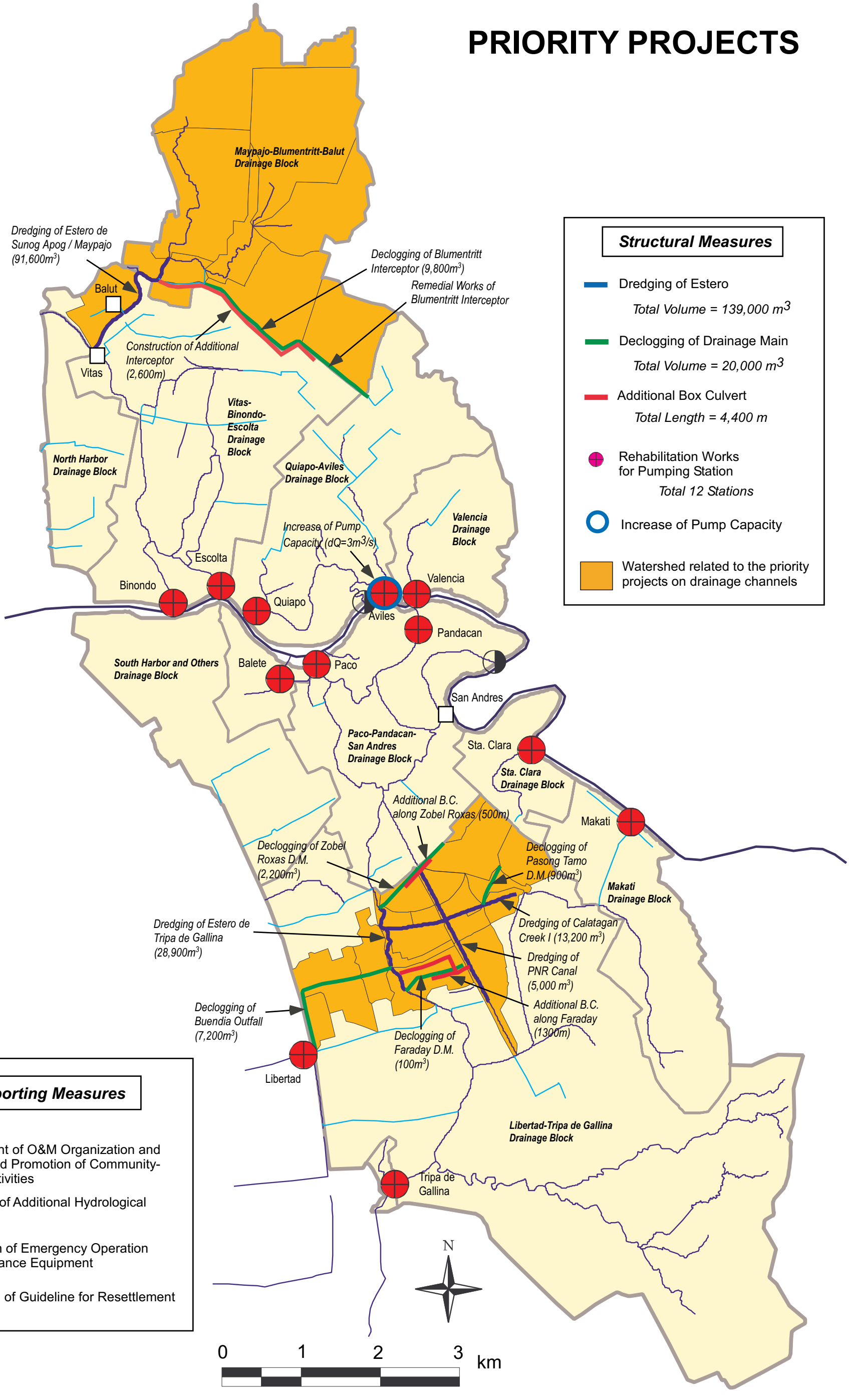
Non-Structural Measures

- Recommendation of Countermeasures for Rapid Urbanization
- Recommendation of Application of Existing Floodplain Management System

Supporting Measures

- Improvement of O&M Organization and Activities
- Installation of Equipment and Facilities for Effective O&M Activities
- Establishment of Community-Involved Solid Waste Management
- Preparation of Guideline for Resettlement

PRIORITY PROJECTS



Structural Measures

- Dredging of Estero
  Total Volume = 139,000 m^3
- Declogging of Drainage Main
  Total Volume = 20,000 m^3
- Additional Box Culvert
  Total Length = 4,400 m
- Rehabilitation Works for Pumping Station
  Total 12 Stations
- Increase of Pump Capacity
- Watershed related to the priority projects on drainage channels

Supporting Measures

- Improvement of O&M Organization and Activities and Promotion of Community-Involved Activities
- Installation of Additional Hydrological Equipment
- Introduction of Emergency Operation and Maintenance Equipment
- Preparation of Guideline for Resettlement

EXECUTIVE SUMMARY

1. INTRODUCTION

The Study on Drainage Improvement in the Core Area of Metropolitan Manila is conducted from February 2004 to February 2005 according to the Implementing Arrangement (I/A) on the Technical Cooperation for the Study, which was agreed upon among the Metropolitan Manila Development Authority (MMDA), the Department of Public Works and Highways (DPWH) and the Preparatory Study Team of Japan International Cooperation Agency (JICA) on February 26, 2003. The implementing agency (or counterpart agency) for the Study is DPWH.

The study area that includes the five Cities of Caloocan, Manila, Pasay, Makati and Quezon and the Municipality of Taguig, covers 73 km² of the core area of Metropolitan Manila The area has a population of 2.58 million, but the area is vulnerable to floods from the Pasig River, storm water of own basin and high tides of Manila Bay, because of its low-lying topography and tropical meteorological/hydrological conditions. The drainage improvement in the core area is one of the major tasks of the National Capital Region.

The objectives of the Study are as follows:

- to formulate a Master Plan of comprehensive drainage improvement for the core area of Metropolitan Manila,
- to conduct a Feasibility Study on the priority projects/areas identified in the Master Plan,
- to prepare guidelines for comprehensive drainage improvement, and
- to transfer technology and knowledge of the method and management of comprehensive drainage improvement to Philippine counterpart personnel in the course of the Study.

The Study has been conducted on the existing drainage conditions through various field studies and formulated a Master Plan of comprehensive drainage improvement for the core area and selected Priority Projects during the Phase 1 (February-August 2004), and conducted the Feasibility Study on the Priority Projects during the Phase 2 (September 2004 - March 2005). In the course of the Study guidelines for comprehensive drainage improvement and technology transfer have been prepared and experimental activities have been conducted for barangay-involved activities at three pilot barangays.

The target year of the Master Plan is set for the year of 2020, with 3 terms: 1st phase (2005 to 2010), 2nd phase (2011 to 2015) and 3rd phase (2016 to 2020). The projects proposed for the 1st Phase are selected as the Priority Projects, because the projects are proposed to improve the inundation conditions (depth and duration) of the severest inundation area in both North Manila and South Manila.

2. FLOOD AND INUNDATION PROBLEMS

Though the countermeasures have been conducted for flood control and stormwater drainage improvement since the 1970s, the frequency of flood and inundation is still high in the core area of Metropolitan Manila. The flood in 1999 records that the flood and inundation affected 1.24 million people, 97,000 houses and about a half of the road networks in the core area, and caused various adverse impacts not only to the core area but also to the national capital region, by causing severe traffic congestions and disturbing business and people's lives.

The severe inundation areas are identified at both North Manila and South Manila and they are as follows:

North Manila: Aviles-Sampaloc area in the Quiapo-Aviles, Vitas-Binondo-Escolta and Maypajo-Blumentritt-Balut drainage blocks.

South Manila: San Isidro-San Antonio-Pio del Pilar area in the Libertad-Tripa de Gallina drainage block.

In North Manila the maximum inundation depth recorded is around 1.3 m, which occurs along España Street, and the area in which the inundation is deeper than 0.5 m, extends widely in the central part. The area, in which the duration of inundation exceeds 24 hours, is also identified. In South Manila, deep inundation occurs along the east side of the PNR canal and along the Estero de Tripa de Gallina, but the duration of inundation is less than 12 hours.

3. MAJOR DRAINAGE PROBLEMS AND COUNTERMEASURES

The core area is mostly low-lying and the stormwater from about 70% (52 km²) of the core area depends on the pump drainage system. The drainage facilities are composed of: 15 major drainage pumping stations, 74 km of esteros/creeks, 35 km of drainage mains/outfalls and about 400 km laterals.

However, the existing major drainage pumping stations mostly become old and need rehabilitation, and the existing drainage channels: esteros/creeks and drainage mains/outfalls have lost their original (or design) capacities due to illegal activities: dumping of solid waste/silt into the drainage channels and encroaching numerous informal house buildings/structures in drainage channels.

The discharge capacities of existing drainage channels are assessed mostly as less than the peak discharge with 2-year return period rainfall event, though they were designed to have the capacities to convey the peak discharge with 10-year return period.

The capacities of the existing drainage channels should be rehabilitated, improved and recovered by dredging/declogging, remedial or related works and additional facilities. The volume of bottom deposits of drainage channels to be dredged and declogged is estimated to be 840,000 m³ in esteros/creeks and 80,000 m³ in drainage mains/outfalls, in order to recover the original capacities of the existing drainage channels. The informal house buildings (or structures) and households which are located inside drainage channels, are estimated at about 2,100 structures and 6,000 households respectively.

The drainage problems necessary to be solved are summarized as follows:

Problems to be solved	Countermeasures
Major drainage pumping stations mostly become old and need urgent rehabilitation.	- Early rehabilitation of drainage pumping equipment
Due to the rapid urban development, some of the drainage systems facilities are difficult to meet the current stormwater runoff.	- Remedial or related works and additional facilities are required for drainage improvement
Most of the drainage channels have lost the design drainage capacities due to the heavy channel bottom deposits.	- Rehabilitation by dredging and declogging - Improvement of solid waste collection system at barangay level by innovating inspection system and enhancing public awareness.
Increase of informal settlers in drainage channels to cause decreasing the drainage capacity and become obstacles for O&M activities.	- Relocation of informal settlers in drainage channels - Reduction of informal activities
Insufficient O&M activities.	- Improvement and strengthening of O&M organizations and activities, including budget increase and barangay-involved activities

4. MASTER PLAN

(1) Main Works Cost

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage channels are estimated as shown in the following table:

Main Works Cost for Improvement and Rehabilitation Works for Drainage Channels

Item			Amount (Million Peso)
Rehabilitation works of drainage channels			1,140.5
N01	Vitas-Binondo-Escolta	Additional works of South Antipolo area	503.0
N02	Quiapo-Aviles	Additional works of channel to Quiapo Pumping Station	307.5
		Additional works for Aviles drainage area	539.2
N04	Maypajo-Blumentritt-Balut	Additional works of Estero de Vitas	18.0
		Additional works of Blumentritt Interceptor	723.2
S01	Libertad-Tripa de Gallina	Additional works for severe inundation area in South Manila	460.1
		Additional works of Libertad pond	522.0
		Additional Works of Dilain/Maricaban Creek area	1,380.8
S02	Balete	Additional works in Estero de Balete	29.1
Total			5,623.4

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage pumping stations are estimated as shown in the following table.

Main Works Cost for Improvement and Rehabilitation Works for Drainage Pumping Stations

Item			Amount (Million Peso)
Rehabilitation works of drainage pumping stations			2,129.0
N02	Quiapo-Aviles	Additional works for Aviles drainage area	160.0
S03	Paco-Pandacan-San Andres	Additional works on Perita Creek	160.0
S04	Sta. Clara	Additional works in Sta. Clara drainage basin	160.0
Total			2,609.0

The estimated cost of main works of the master plan projects is shown below.

- **Total main works cost:** **Php8,232.4 million**
- Rehabilitation works of drainage channels: Php1,140.5 million
- Rehabilitation works of drainage pumping stations: Php2,129.0 million
- Additional works in North Manila: Php2,250.9 million
- Additional works in South Manila: Php2,712.0 million

(2) Other Costs

1) Resettlement cost:

- **Total resettlement cost:** **Php1,510.6 million**
- Resettlement cost excluding land acquisition cost: Php1,289.6 million
- Land acquisition cost for relocation site: Php221.0 million

2) Compensation cost for additional works

- **Total compensation cost for additional works:** **Php3.8 million**
- Land acquisition: Php0.8 million
- House compensation: Php3.0 million

3) Cost for supporting measures

- **Total cost for BEM and Team ESTERO activities:** **Php417.8 million**
- **Total cost for IEC campaign:** **Php71.1 million**

4) Other supporting measures cost

- **Total other supporting measures cost:** **Php177.6 million**
- Various management systems: Php138.5 million
- Additional hydrological equipment: Php1.5 million
- Emergency operation and maintenance equipment: Php37.6 million

Note: The cost is included in civil works cost.

5) Operation and maintenance cost

- **Total O&M cost:** **Php241.0 million per annum**

(3) Project Cost

In line with the above conditions, the project cost is estimated. The total project cost is Php15,367.3 million as summarized in the following table.

Project Cost

Item	Amount (Php million)	Remarks
1. Civil Work	9,703.8	
1.1 Preparatory	411.6	5 % of (1.2)
1.2 Main	8,232.4	
1.3 Other supporting measures	177.6	
1.4 Miscellaneous	882.2	10 % of (1.1+1.2+1.3)
2. VAT	970.4	10 % of (1)
3. Resettlement and Compensation Cost	1,590.1	
3.1 Resettlement cost	1,510.6	
3.2 Compensation cost for additional works	3.8	
3.3 Miscellaneous	75.7	5 % of (3.1+3.2)
4. Government Administration Cost	291.1	3 % of (1)
5. Engineering Services	970.4	10 % of (1)
6. Physical Contingency	1,352.6	10 % of (1+2+3+4+5)
7. Supporting Measure Cost		
7.1 BEM and Team ESTERO	417.8	
7.2 IEC	71.1	
Total	15,367.3	

Total project cost is approximately broken down into the respective 3 phases as follows.

- 1st Phase: Php5,503.9 million
- 2nd Phase: Php5,419.4 million
- 3rd Phase: Php4,444.0 million

(4) Project Justification

1) Technical aspect

The estimated reduction of the floods and inundation damages by the project is evaluated as a part of the impact from the technical aspect. Though 87,000 houses and a half of the roads (1,389 km) were affected in the 1999 floods and inundation, affected population numbers and road networks will be significantly reduced by the project due to the reduction of the depth and duration of the floods and inundation, and the damages caused by the flood and inundation could be minimized with the completion of the Master Plan.

2) Economic aspect

The economic viability of the optimum plan is thus figured out as follows.

Results of Economic Analysis (Future Condition)

NPV	Php27,595 mil.
B/C	5.2
EIRR	42.8%

Source: JICA Study Team

Though social infrastructure projects such as flood control and drainage improvement works are in general put into implementation even at the lower EIRR, compared with other productive projects, the master plan shows a very high viability of 42.8% in EIRR (Future Condition), likewise resulting in high values of B/C (5.2) and NPV (Php27,595 million) for the conceivable reason that socio-economic needs for flood prevention in the study area where the central function of the political and economic activity locates will augment to a maximum degree.

In this context, the Master Plan can be justified from the economic viewpoint to take a next step in accordance with the proposed schedule.

3) Financial aspect

The master plan would be effective to mitigate the damages caused by floods and inundation in the capital area and feasible from technical, economic, and social and environmental aspects. It is surely worthwhile for the Government of the Philippines to consider the increase of budgetary allocation to the floods and drainage improvement in the capital area.

When the annualized cost of proposed cost of Master Plan is compared to the average amount of total expenditure of MMDA and the 6 LGUs for the past 6 years, it is fairly huge and requires almost 1.5 times of annual budget in order to implement the Master Plan.

While, on the assumption that the JBIC loan or other resources of ODA would be appropriated to the Master Plan, the required share of the Government of the Philippines is equivalent to around 31% to present expenditures, and that the said burden is not prohibitive level of their expenditures from the aspect of the financial status of the relevant authorities.

The Government of the Philippines needs to consider the financial arrangement for the implementing agencies to implement the Master Plan.

4) Social and environmental aspects

Major issues related to social and environmental aspects are as follows:

- The rehabilitation of the drainage channels proposed in the Master Plan requires relocation of informal settlers living in houses/structures on the drainage channels before dredging, until the target year of 2020. The families to be resettled during the Master Plan (from 2005 to 2020) are estimated to be about 5,500. It is proposed that the Government of the Philippines shall arrange and develop resettlement sites based on a Resettlement Action Plan (RAP) prepared according to the guidelines for social framework of resettlement proposed in the Study.
- The rehabilitation works also require dredging/declogging a huge volume of bottom deposits of drainage channels, which is estimated to be about 920,000 m^3. It is proposed that the Government of the Philippines shall arrange and develop disposal sites for the dredged materials.

(5) Implementation Plan

1) Implementation agency

It is necessary to decide the implementing agency for the projects and to establish a coordination committee for smooth implementation of the Master Plan and the Priority Projects. DPWH should have a function to coordinate the related government organizations as the main implementing agency for the Study in order to attain the aim of drainage improvement in the core area of Metropolitan Manila.

Though the drainage facilities and solid waste management in the core area of Metropolitan Manila are now under the responsibility of MMDA and LGUs; the implementation of the proposed Master Plan and Priority Projects will require the involvement of various national and local agencies including DPWH, MMDA, NHA LGUs and others as well as a good coordination among them in order to carry out the drainage improvement project.

2) Implementing schedule

Target year of the Master Plan is se at the year of 2020, and divided into three terms as follows

- 1st Phase from 2005 to 2010
- 2nd Phase from 2011 to 2015
- 3rd Phase from 2016 to 2020

The target year of the Master Plan is 2020 and it is scheduled in three phases. Implementation and disbursement schedules are shown in *Figure 1* and *Table 1*, respectively.

(6) Preparation of Guideline for Social Framework of Resettlement

In order to recover the drainage capacity of the existing drainage channels, the relocation of informal settlers who live in house buildings within the drainage should be required. For removal of informal houses buildings (Phase 1: 285, Phase 2: 665, Phase 3: 950) and relocation of informal settlers, the following issues should be considered:

- Every effort should be made to avoid unwilling relocation such as “summary eviction”
- Participation of project affected people on creating a better solution for resettlement is crucial.
- Clarification of the responsibility and fulfillment of the mandate of the implementing agency, and establishment of a coordination committee consisting of relating agencies: LGUs, MMDA, DPWH, NHA, HUDCC etc., is necessary.
- Establishment of uniformed standard in application of RA 7279 is recommended.
- Resettlement sites with basic infrastructure are fundamental.
- A separate third party Monitoring team that can monitor the entire resettlement operation throughout the project from the initial stage of the project should be established.
- Dynamics and capacity of the people should be considered as resources

(7) Priority Projects

The projects proposed for the Phase 1 in the Master Plan are selected as the Priority Projects, because the projects selected for the Phase 1 are proposed to improve the inundation conditions (depth and duration) of the severest inundation areas in both North Manila and South Manila. The Priority Projects are composed of structural measures: rehabilitation of drainage facilities, remedial (or related) works and additional facilities, and non-structural supporting measures.

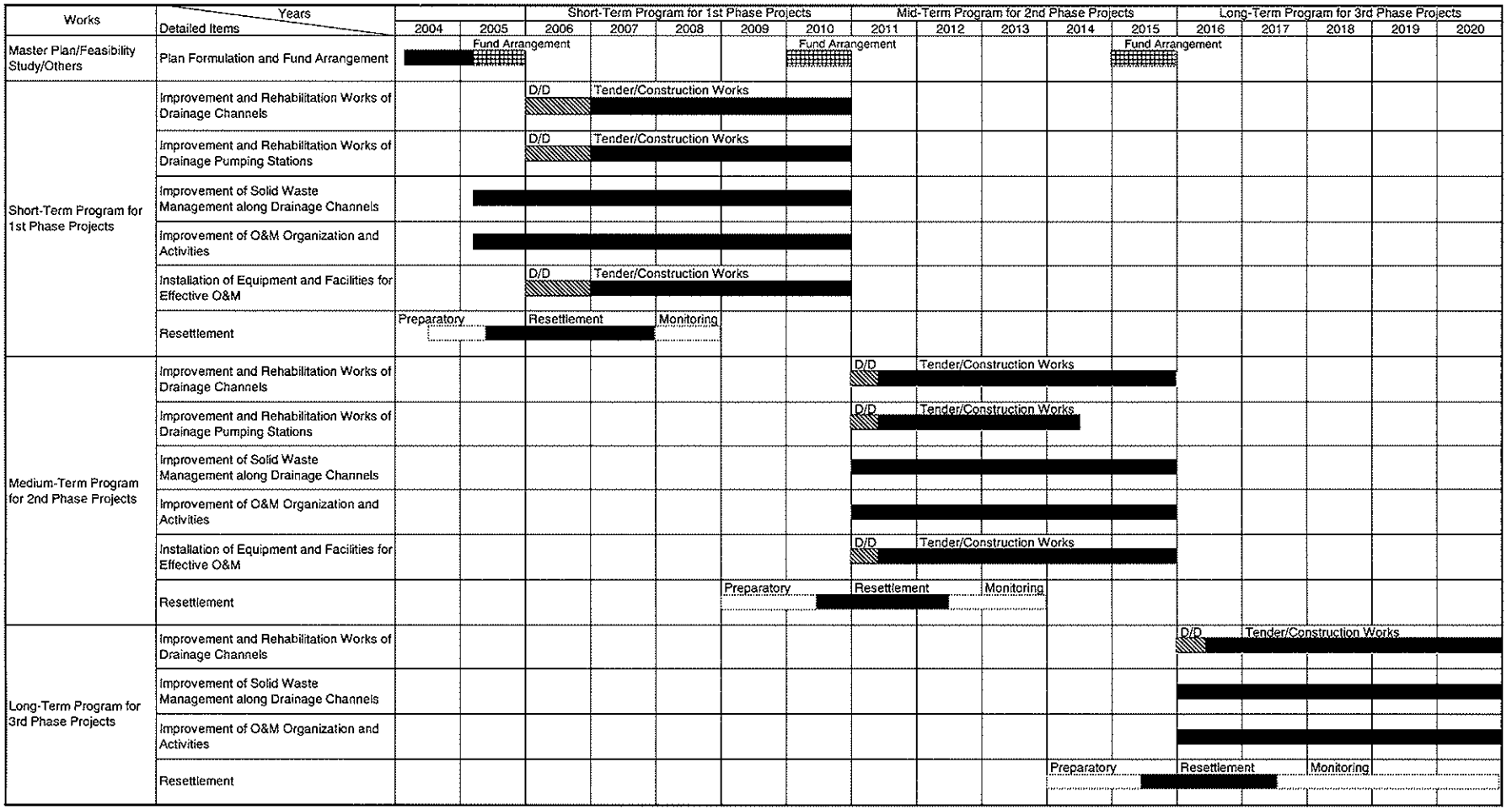


Figure 1 Implementation Schedule of the Master Plan

Table 1 Disbursement Schedule of the Master Plan

Unit: Million Peso

Work Item	Project Cost				Phase 1						Phase 2					Phase 3					Total
	Phase 1	Phase 2	Phase 3	Total	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Civil Works	3,806.9	3,432.0	2,464.9	9,703.8	0	0	0	2315	756.1	735.5	0	156.2	1160.2	1069.3	1046.3	0	117.4	782.7	782.5	782.3	9703.8
1) Preparatory	162.9	142.0	106.7	411.6	0	0	0	162.9	0	0	0	142.0	0	0	0	0	106.7	0	0	0	411.6
2) Main	3,258.8	2,839.5	2,134.1	8,232.4	0	0	0	1921.6	668.6	668.6	0	0	1008.5	925.9	905.1	0	0	711.5	711.4	711.2	8232.4
- Rehabilitation of Drainage Channels	199.8	514.5	426.2	1,140.5	0	0	0	40.0	79.9	79.9	0	0	171.5	171.5	171.5	0	0	142.1	142.1	142.0	1140.5
- Additional Works in North Manila	723.2	1,229.7	298.0	2,250.9	0	0	0	144.6	289.3	289.3	0	0	409.9	409.9	409.9	0	0	99.4	99.3	99.3	2250.9
- Additional Works in South Manla	330.8	971.3	1,409.9	2,712.0	0	0	0	66.2	132.3	132.3	0	0	323.8	323.8	323.7	0	0	470.0	470.0	469.9	2712.0
- Rehabilitation of Pumping Station	2,005.0	124.0	0	2,129.0	0	0	0	1670.8	167.1	167.1	0	0	103.3	20.7	0	0	0	0	0	0	2129.0
3) Other Supporting Measures	39.1	138.5	0	177.6	0	0	0	20.3	18.8	0	0	0	46.2	46.2	46.1	0	0	0	0	0	177.6
4) Miscellaneous	346.1	312.0	224.1	882.2	0	0	0	210.5	68.7	66.9	0	14.2	105.5	97.2	95.1	0	10.7	71.2	71.1	71.1	882.2
VAT	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Resettlement and Compensation Cost	241.8	555.2	793.1	1590.1	95.1	95.1	51.6	0	0	222.1	222.1	111	0	0	317.2	317.2	158.7		0	0	1590.1
1) Resettlement Cost	226.5	528.8	755.3	1510.6	90.6	90.6	45.3	0	0	211.5	211.5	105.8	0	0	302.1	302.1	151.1		0	0	1510.6
2) Compensation Cost for Additional Works	3.8	0	0	3.8	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	3.8
3) Miscellaneous	11.5	26.4	37.8	75.7	4.5	4.5	2.5	0	0	10.6	10.6	5.2	0	0	15.1	15.1	7.6	0	0	0	75.7
Government Administration Cost	114.2	103.0	73.9	291.1	0	0	0	69.4	22.7	22.1	0	4.7	34.8	32.1	31.4	0	3.5	23.5	23.5	23.4	291.1
Engineering Services	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Physical Contingency	492.4	477.7	382.5	1352.6	9.5	9.5	5.2	284.8	93	112.7	22.2	30.3	142.7	131.5	160.4	31.7	30.3	96.3	96.3	96.2	1352.6
			Sub-Total		104.6	104.6	56.8	3132.5	1023.0	1239.6	244.3	333.4	1569.9	1446.7	1764.5	348.9	333.3	1059.1	1058.9	1058.3	14878.4
Supporting Measure Cost	87.2	165.1	236.6	488.9	8.2	9.6	12.4	16.7	18.6	21.7	26.7	29.1	32.6	37.1	39.6	42	45.6	46.9	49.4	52.7	488.9
1) BEM and Team ESTERO	63.3	141.5	213	417.8	3.4	5.9	8.7	12	15.1	18.2	21.3	24.8	28.3	31.8	35.3	37.7	40.2	42.6	45.1	47.4	417.8
2) IEC	23.9	23.6	23.6	71.1	4.8	3.7	3.7	4.7	3.5	3.5	5.4	4.3	4.3	5.3	4.3	4.3	5.4	4.3	4.3	5.3	71.1
				Total	112.8	114.2	69.2	3149.2	1041.6	1261.3	271.0	362.5	1602.5	1483.8	1804.1	390.9	378.9	1106.0	1108.3	1111.0	15367.3

5. FEASIBILITY STUDY ON PRIORITY PROJECTS

(1) Project Cost

1) Main works cost

The works are composed of 3 lots and 11 projects. The main works cost is shown in the following table.

Civil Works Costs of Respective Works

Sub Project	Civil Works Cost (million Pesos)	Procurement of Contractor /Equipment
Lot I: Rehabilitation and Additional Works for Drainage Channel Facilities in North Manila		
1. Estero de Sunog Apog I	20.4	LCB
- Dredging	20.4	
2. Estero de Sunog Apog II	166.7	LCB
- Dredging	166.7	
3. Blumentritt Interceptor	563.2	ICB
- Declogging of existing Blumentritt Interceptor	43.6	
- Construction of additional Blumentritt Interceptor	519.6	
4. Sub total	**750.3**	
Lot II: Rehabilitation and Additional Works for Drainage Channel Facilities in South Manila		
1. Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I	87.5	LCB
- Dredging	87.5	
2. Buendia Outfall	43.5	ICB
- Declogging	43.5	
3. Zobel Roxas Drainage Main	54.9	ICB
- Declogging	7.5	
- Construction of additional box culvert	47.4	
4. Pasong Tamo Drainage Main	2.9	LCB
- Declogging	2.9	
5. Faraday Drainage Main	269.3	ICB
- Declogging	0.3	
- Construction of additional box culvert	269.0	
6. Sub total	**458.1**	
Lot III: Rehabilitation and Additional Works of Pumping Stations		
1. Rehabilitation of 12 Pumping Stations	2,005.0	ICB
- Group 1 (Aviles,Quiapo,Valencia,Tripa de Gallina)	1,057.0	
- Group 2 (Pandacan, Paco, Sta. Clara, Libertad, Makati, Binondo)	880.0	
- Group 3 (Escolta and Balete)	68.0	
2. Sub total	**2,005.0**	
Installation of Equipment and Facilities for Effective O&M Activities	39.1	ICB
1. Emergency O&M equipment	37.6	
2. Rainfall and water level observation facilities	1.5	
3. Sub total	**39.1**	
Grand Total	**3,252.5**	

2) Cost for resettlement (700 families)

- **Total resettlement cost:** **Php192.2 million**
- Resettlement cost excluding land acquisition cost: Php164.1 million
- Land acquisition cost for relocation site: Php28.1 million

3) Cost for compensation for additional works

- **Total compensation cost for additional works: Php19.1 million**
- Land acquisition: Php2.3 million
- House compensation: Php16.8 million

4) Cost for community-involved solid waste management

- **Total cost for community-involved SWM: Php87.2 million**
- Cost for BEM and Team ESTERO activities: Php63.3 million
- Cost for IEC: Php23.9 million

5) Cost for installation of equipment and facilities for effective O&M activities

- **Total cost for installation of equipment and facilities: Php39.1 million**
- Cost for emergency O&M equipment: Php37.6 million
- Cost for additional hydrological equipment: Php1.5 million

Note: The cost is included in civil works cost.

6) Annual O&M cost

- **Annual cost for operation and maintenance activities: Php241.0 million**

(2) Project Cost

The project cost of the priority projects except price contingency is estimated at Php4,952.0 million as shown in the following table.

Project Cost

Item	Amount (million Pesos)	Remarks
1. Civil Works cost	3,415.1	
1.1 Main works	3,252.5	incl. preparatory/temporary cost
1.2 Miscellaneous	162.6	5 % of (1.1)
2. VAT	341.5	10 % of (1)
3. Resettlement and Compensation Cost	221.9	
3.1 Resettlement cost	192.2	
3.2 Compensation cost for additional works	19.1	
3.3 Miscellaneous	10.6	5 % of (3.1+3.2)
4. Government administration cost	102.5	3 % of (1)
5. Engineering services cost	341.5	10 % of (1)
6. Physical contingency	442.3	10 % of (1+2+3+4+5)
7. Supporting measures cost	87.2	
7.1 BEM and Team ESTERO	63.3	
7.2 IEC	23.9	
8. Total project cost	4,952.0	

Note: US$1.0=Php55=JY110 (July 2004)

(3) Project Justification

The economic viability of the priority projects was thus figured out as follows.

Results of Economic Analysis (Future Condition, Priority Projects, All Study Area)

NPV	Php 12,191 mil.
B/C	4.3
EIRR	36.6 %

In line with the same reason as described in the Master Plan, the priority projects also can be justified from the economic viewpoint to take a next step in accordance with the proposed schedule.

(4) Implementation Program

1) Implementation agency

The drainage facilities and solid waste management in the core area of Metropolitan Manila are now under the responsibility of MMDA and LGUs, however, the implementation of the proposed Master Plan and Priority Projects will require the involvement of many agencies including DPWH, MMDA, NHA, LGUs and others in order to carry out the drainage improvement project as well as to maintain a good coordination among them.

It is necessary to decide an implementing agency for the implementation of projects and to establish a coordination committee for smooth implementation of the Master Plan and Priority Projects.

It is proposed that DPWH coordinate the related government organizations as the main implementing agency for the Study in order to attain the aim of drainage improvement in the core area of Metropolitan Manila.

2) Implementation Schedule

The target year of the Priority Projects is 2010. The implementation and disbursement schedules are shown in *Figure 2* and *Table 2*.

(5) Resettlement

1) Resettlement action plan guideline

The Action Plan may include, at the least, the following items and contents.

- Rationale and Objectives
- Project Description that includes its Scope and Schedule
- Scale and Types of Impacts
- Legal Bases
- Resettlement Site
- Socio-Economic Profile of the Affected Families and Communities
- Setting of Cut-Off Date
- Compensation
- Demolition Date
- Public Consultation and Hearing
- Options for Resettlement Assistance
- Post-Relocation Assistance for Reconstruction of Livelihood
- Provision of Social Services
- Grievance and Complaints
- Monitoring
- Funds Sources

2) Considerations required

There are particular things to be considered in the preparation of the Resettlement Action Plan in order to have a clear picture of the Plan. First requirements are to draw:

- A flow chart of the resettlement operation plan by step of tasks
- A matrix to explain what section of responsible organization(s) will work on each component/step/task and how many staff members shall be assigned
- What kinds of groups shall be organized at the barangay level and the government level to assist the PAFs on resettlement such as Task Force, Inter-Agency Committee, Monitoring Team, etc. and their duties.

(6) Experimental Activities at Pilot Barangay

The following barangays have been selected as experiment sites on environmental management:

Manila City：Barangay 195 (Population: 1249)
Pasay City： Barangay 46 (Population: 4509)
Makati City：Barangay Palanan (Population: 16,614)

Community activities being conducted by Experiment are as follows:

- Conduct of IEC at barangay level
- Garbage/solid waste collection management at barangay level
- Cleaning of drainage channels at barangay level
- Pollution control at barangay level

The results of the experiment show the effectiveness of barangay environmental management activities with the appointment of a Barangay Environmental Manager (BEM) and the formation of Team ESTERO (Environmental Strategic Task for Estero Renewal Organization). The barangay people that participated in the experiment mostly have a positive attitude towards the process experienced in the experimental activities and the promotion of community-involved solid waste collection management and maintenance of drainage channels.

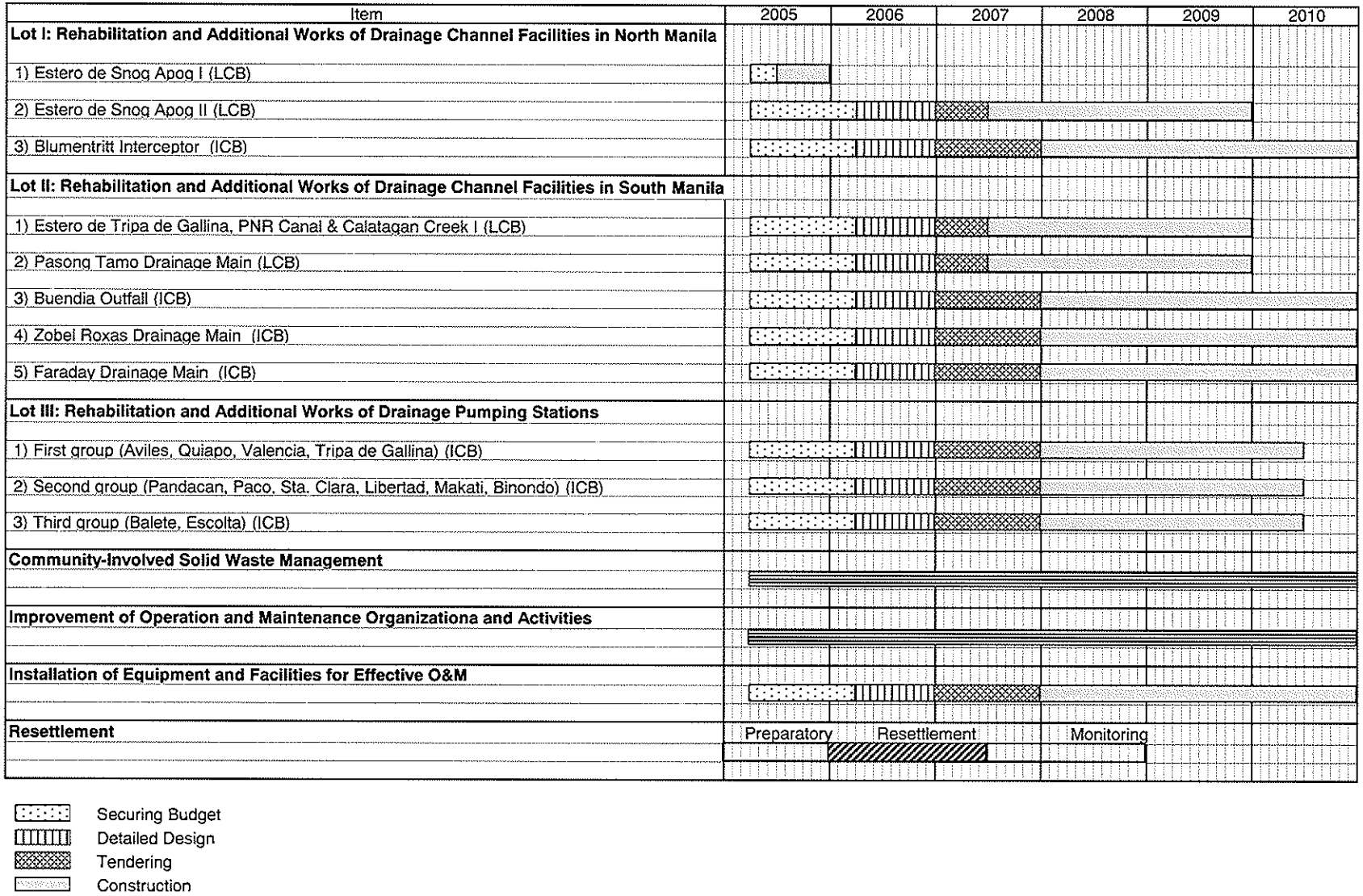


Figure 2 Implementation Schedule of the Priority Projects

Table 2 Disbursement Schedule of the Priority Projects

Unit: Million Peso

Work Item	Project Cost	Year						Total
		2005	2006	2007	2008	2009	2010	
Civil Works	3,415.1	21.4	0.0	53.9	2209.6	629.0	501.2	3,415.1
1) Main	3,252.5	20.4	0.0	51.3	2104.4	599.1	477.3	3,252.5
- Rehabilitation and Additional Works for Drainage Channel facilities in North Manila	750.3	20.4	0	33.3	254.5	254.4	187.7	750.3
a) Estero de Sunog Apog I	20.4	20.4	0	0	0	0	0	20.4
b) Estero de Sunog Apog II	166.7	0	0	33.3	66.7	66.7	0	166.7
c) Blumentritt Interceptor	563.2	0	0	0	187.8	187.7	187.7	563.2
- Rehabilitation and Additional Works for Drainage Channel facilities in South Manila	458.1	0	0	18	158.8	158.8	122.5	458.1
a) Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I	87.5	0	0	17.5	35	35		87.5
b) Buendia Outfall	43.5	0	0	0	14.5	14.5	14.5	43.5
c) Zobel Roxas Drainage Main	54.9	0	0	0	18.3	18.3	18.3	54.9
d) Pasong Tamo Drainage Main	2.9	0	0	0.5	1.2	1.2		2.9
e) Faraday Drainage Main	269.3	0	0	0	89.8	89.8	89.7	269.3
- Rehabilitation of Pumping Station	2,005.0	0	0	0	1671	167.1	167.1	2,005.0
a) Group 1	1,057.0	0	0	0	880.8	88.1	88.1	1,057.0
b) Group 2	880.0	0	0	0	733.4	73.3	73.3	880.0
c) Group 3	68.0	0	0	0	56.6	5.7	5.7	68.0
- Installation of Equipment and Facilities	39.1	0	0	0	20.3	18.8	0.0	39.1
2) Miscellaneous	162.6	1	0	2.6	105.2	29.9	23.9	162.6
VAT	341.5	2.1	0.0	5.4	221.0	62.9	50.1	341.5
Resettlement and Compensation Cost	221.9	0	134.5	87.4	0	0	0	221.9
1) Resettlement Cost	192.2	0	128.1	64.1	0	0	0	192.2
2) Compensation cost for additional works	19.1	0	0	19.1	0	0	0	19.1
3) Miscellaneous	10.6	0	6.4	4.2	0	0	0	10.6
Government Administration Cost	102.5	0.6	0	1.6	66.3	18.9	15.1	102.5
Engineering Services	341.5	2.1	0	5.4	221	62.9	50.1	341.5
Physical Contingency	442.3	2.6	13.5	15.4	271.7	77.4	61.7	442.3
Sub-Total		28.8	148.0	169.1	2989.6	851.1	678.2	4,864.8
Supporting Measure Cost	87.2	8.2	9.6	12.4	16.7	18.6	21.7	87.2
1) BEM and Team ESTERO	63.3	3.4	5.9	8.7	12	15.1	18.2	63.3
2) IEC	23.9	4.8	3.7	3.7	4.7	3.5	3.5	23.9
Total		37.0	157.6	181.5	3006.3	869.7	699.9	4,952.0

6. CONCLUSION AND RECOMMENDATION

The proposed Master Plan and Priority Projects for the core area are effective in terms of technical, economic, social and environmental aspects for drainage improvement in the core area. By the implementation of the proposed drainage improvement plan, the severe inundation area will significantly be reduced and improved. It is recommended for the Government of the Philippines to take immediate actions for the implementation of the proposed measures, because the core area of Metropolitan Manila is very important economically and socially in the country, but extremely vulnerable to flood and inundation problems. The Study recommends the actions as follows.

(1) The rehabilitation of the existing major drainage facilities: drainage channels and drainage pumping stations, shall be conducted according to the proposed schedule in order to prevent/mitigate the damages caused by floods and inundation in the core area of Metropolitan Manila. The Priority Projects identified in the Master Plan shall require immediate actions, and be conducted duly according to the schedule.

(2) The relocation of informal settlers living inside the target drainage channels (esteros/creeks) shall be conducted before dredging. The implementing agencies shall select resettlement sites and prepare a "Resettlement Action Plan" for the Priority Projects and the Master Plan through a series of public consultation, based on the resettlement guideline prepared in the Study and the JICA guideline for environmental and social awareness, and shall avoid executing any summary evictions and returnees. Although there are some structures encroaching partly the drainage channel, the detailed number of project affected people for relocation or structure for compensation shall be decided based on the detailed design.

(3) The O & M organizations shall be improved and barangay-involved O & M system shall be established, and those organization shall conduct not only proper O & M activities for drainage facilities but also carry the responsibility for proper solid waste collection management at the barangay level to avoid illegal activities for sustaining the capacity of the drainage facilities after the rehabilitation/improvement of drainage channels.

(4) The major drainage pumping stations require detailed rehabilitation programs through overhauling and the 12 drainage pumping stations require rehabilitation, but the 4 drainage pumping stations: Quiapo, Aviles, Valencia and Tripe de Gallina, are critical conditions requiring immediate actions for rehabilitation.

(5) The implementing agency shall be decided and organize a coordination committee for the implementation of the Master Plan and Priority Projects, because the implementation of the Master Plan and Priority Projects shall require various concerned central and local government agencies and stakeholders.

(6) The barangay environmental management shall be extended to other barangay along esteros/creeks to promote the community participation for improvement of various barangay activities including improvement/sustainment of the drainage capacity. The BEM (Barangay Environmental Manager) and Team ESTERO (Environmental Strategic Task for Estero Renewal Organization) activities conducted at three pilot barangays (Manila: Barangay 195, Pasay: Barangay 46, Makati: Barangay Palanan) as an experiment, would be an effective way for enhancement of public awareness through public education, for promotion of public participation for solid waste collection management as well as for prevention against illegal activities like dumping solid waste into drainage channels and informal settlement in public spaces.

(7) The database for the Study, which has been developed and transferred to the implementing agency and concerned organizations (DPWH, MMDA and LGUs), shall be utilized and updated periodically for the O & M of drainage facilities and the coordinated activities shall be required among the concerned agencies.

(8) DPWH as the implementing agency shall take the initiative to continue the preparation for the implementation of Priority Projects as follows:

- Preparation of the Environmental Impact Statement (EIS) based on the Environmental Impact Assessment (EIA) prepared in the Study and get an Environmental Compliance Certificate (ECC) for Priority Projects.
- Preparation of a Resettlement Action Plan (RAP) shall be conducted according to the proposed the guideline of social awareness and resettlement, enough consideration of necessary social and basic infrastructures.
- Preparation of Implementation Program (IP) for financial arrangement shall include necessary measures for drainage improvement of the core area of Metropolitan Manila and also necessary measures required for the resettlement plan.
- Preparation for resettlement sites for the Phases 2 and 3 in the Master Plan shall be conducted according to the proposed relocation schedule of project affected people along the drainage channels.
- Preparation for countermeasures for rapid urbanization to lower runoff coefficient shall be conducted in order to establish sustainable drainage system.

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7. IMPLEMENTATION PROGRAM

ABBREVIATION

AASHTO: American Association of State Highway and Transportation Official
ABC: Association of Barangay Captains
ADB: Asian Development Bank
ASEP: Association of Structural Engineers of the Philippines
ATC: Applied Technical Council
BOC: Bureau of Construction
BOD: Bureau of Design
BOE: Bureau of Equipment
BOM: Bureau of Maintenance
BPW: Bureau of Public Works
CH: City Hall
CHR: Commission for Human Rights
CIDSS: Comprehensive and Integrated Delivery of Social Service
CLUP: Comprehensive Land Use Plan
CMP Community Mortgage Program
CSC: Civil Service Commission
DAO: DENR Administrative Order
DBM: Department of Budget and Management
DBP Development Bank of Philippines
DECS: Department of Education, Culture and Sports
DILG: Department of the Interior and Local Government
DENR: Department of Environment and Natural Resources
DPWH: Department of Public Works and Highways
DSWD: Department of Social Welfare and Development
DOF: Department of Finance
DOH: Department of Health:
DOT: Department of Tourism
DOTC: Department of Transportation and Communications
DWO: Drainage and Waterways Operation, MMDA
ECC: Environmental Compliance Certificate
EIA: Environmental Impact Assessment
EIS: Environmental Impact Statement
EFCOS: Effective Flood Control and Operation System
FAPs: Foreign Assisted Projects
FCDD: Flood Control and Drainage Division. DPWH
FCSEC: Flood Control and Sabo Engineering Center
GDP: Gross Domestic Product
GIS: Geographic Information System
GOJ: Government of Japan
GOP: Government of Republic of the Philippines
GNP: Gross National Product
GPS: Global Positioning System
GRDP: Gross Regional Domestic Product
GSIS: Government Service Insurance System
HES: Human Ecology and Security
HGC: House Guarantee Corporation
HDMF: Home Development Mutual Fund
HIGC: Home Insurance Guaranty Corporation (Now called HGC)
HLURB: The Housing and land Used Regulatory Board
HUDCC: Housing and Urban Development Coordinating Council
ICSI: Institute of Church and Social Issues
IBRD: International Bank for Reconstruction and Development (World Bank)

JICA: Japan International Cooperation Agency
JBIC: Japan Bank for International Cooperation
LGC: Local Government Code
LGU: Local Government Unit
LGU-Makati: Local Government Unit Makati City
LGU-Manila: Local Government Unit City of Manila
LGU-Pasay: Local Government Unit Pasay City
LRT: Light Rail Transit
MBN: Minimum Basic Needs
MDF: Municipal Development Fund
MLLW: Mean Lower Low Water Level
MMC: Metropolitan Manila Council
MMDA: Metropolitan Manila Development Authority
MNH: Manila North Harbor
MSH: Manila South Harbor
MSL: Mean Sea Level
MWSS Metropolitan Waterworks and Sewerage System
NAIA: Ninoy Aquino International Airport
NAMRIA: National Mapping and Resources Information Authority
NAPC: National Anti-Poverty Commission
NCR: National Capital Region, DPWH
NCSO: National Census and Statistics Office
NDCC: National Disaster Coordinating Council
NEDA: National Economic and Development Authority
NGO: Non-Government Organization
NHA: National Housing Authority
NAMRIA: National Mapping & Resources Information Authority
NHMFC: National Home Mortgage Finance Corporation
North Manila: North or right bank of the Pasig River
NSO: National Statistics Office
NWRB: National Water Resources Board
NWSS: Manila Waterworks and Sewerage System
OCD: Office of Civil Defense
OECF: Oversea Economic Cooperation Fund
PAGASA: Philippines Atmospheric, Geophysical & Astronomical Services Administration
PCUP: Presidential Commission for the Urban Poor
PD: Presidential Decree
PPA: Philippine Port Authority
PNP: Philippine National Police
PSFO: Pumping Stations and Floodgates Operation, MMDA
PMO: Project Management Office
PNR: Philippine National Railway
PO: People's Organization
PRRC: Pasig River Rehabilitation Commission
RA: Republic Act
South Manila: South or left bank of the Pasig River
SSS: Social Security System
SWMO: Solid Waste Management Office
TWG: Technical Working Group
UDHA: Urban Development and Housing Act
UNHCR: United Nations High Commissioner for Refugees
UN-OCHA: United Nations Office for the Coordination of Humanitarian Affaires
UTM: Universal Transverse Mercator Projection
UP: University of Philippines
UPO: Urban Poor Organization

WB: World Bank
WHO: World Health Organization

(Study and Project)

MMEIRS: Earthquake Impact Reduction Study for Metropolitan Manila (JICA), 2004
MMUTIS: Metro Manila Urban Transport Integration Study, 1999
PRDP: Pasig River Environment Management and Rehabilitation Sector & Development Program
SEDLMM: Study on the Existing Drainage Laterals in Metro Manila (JICA), 2000

(Unit)

ha: Hectare
Php: Philippine peso

1. INTRODUCTION

1.1 BACKGROUND

This is a Summary of the Final Report of "the Study on Drainage Improvement in the Core Area of Metropolitan Manila", which is, in response to the request of the Government of Philippines, conducted by the Government of Japan, through JICA, which is the official agency responsible for the implementation of technical cooperation programs of the Government of Japan.

The Study has been carried out according to the Implementing Arrangement (I/A) on the Technical Cooperation for the Study, which was agreed upon among the Metropolitan Manila Development Authority (MMDA), the Department of Public Works and Highways (DPWH) and the Preparatory Study Team of Japan International Cooperation Agency (JICA) on February 26, 2003.

The study objectives are as follows:

- to formulate a Master Plan of comprehensive drainage improvement for the core area of Metropolitan Manila,
- to conduct a Feasibility Study on the priority projects/areas identified in the Master Plan,
- to prepare guidelines for comprehensive drainage improvement, and
- to transfer technology and knowledge of the method and management of comprehensive drainage improvement to Philippine counterpart personnel in the course of the Study.

The study area composed of the five Cities of Caloocan, Manila, Pasay, Makati and Quezon and the Municipality of Taguig and covers 73 km² of the core area of Metropolitan Manila.

The area has a population of about 2.58 million, but vulnerable to floods from the Pasig River, storm water of own basin and high tides of Manila Bay, because of its low-lying topography and tropical meteorological/hydrological conditions. The drainage improvement in the core area is one of the major tasks of the National Capital Region.

The Study has been conducted on the existing drainage conditions through various field studies and formulated a Master Plan and selected priority projects for drainage improvement in the core area during the 1st Phase (February-August 2004), and the Feasibility Study has been carried out on the Priority Projects during the 2nd Phase (September 2004 - March 2005). In the course of the Study guidelines for comprehensive drainage improvement have been prepared and technology transfer has been conducted.

The target year of the Master Plan is set for the year of 2020, with 3 terms: 1st phase (2005 to 2010), 2nd phase (2011 to 2015) and 3rd phase (2016 to 2020). The projects proposed for the 1st Phase are selected as the Priority Projects, because the projects are proposed to improve the inundation conditions (depth and duration) of the severest inundation area in both North Manila and South Manila.

1.2 BASIC APPROACH

Based on the existing drainage problems the basic approach for the Study is to identify optimum measures to solve the existing drainage problems from technical, institutional and community participation aspects. In order to cope with the drainage problems in the core area, the Study has been conducted with due consideration of the existing drainage conditions as follows:

(1) Through investigation and analysis on the existing drainage systems, land use, drainage facilities and their discharge capacities, the problems are identified, and the existing

drainage systems are assessed with and without improvement conditions by the hydrological and hydraulic model (MOUSE) developed for the Study.

(2) The existing drainage channels have mostly been without their original discharge capacities because of heavy illegal dumping of solid waste in drainage channels and numerous informal settlers encroaching drainage channels. The basic measures are to recover the original discharge capacities of the existing drainage channels by relocation of informal settlers and by dredging.

(3) The flood/inundation area maps in the 1999 flood have been prepared for the Study. Based on the maps the severe inundation areas are identified in the core area and improvement measures by remedial or related works and additional facilities are studied.

(4) The existing conditions of dumped solid waste have been surveyed at 5 major drainage pumping stations and 20 spots at drainage channels, in order to assess bottom deposits and solid waste dumped into the drainage channels.

(5) O & M organizations, their activities and barangay involved system have been investigated for major pumping stations, drainage channels and solid waste collection management, because proper O & M activities are fundamental for improving and sustaining the discharge capacities of existing drainage channels. For that purposes experimental activities have been conducted for barangay environmental management at three pilot barangays.

(6) Illegal activities and informal settlers have been investigated along drainage channels through questionnaire and interview surveys because the public participation shall be a basic need for improvement and sustainability of the capacity of drainage facilities.

In order to conduct proper O & M activities and to reduce heavy sedimentation and dumped solid waste, the problem caused by informal activities and informal settlers in/along drainage channels should be informed to the public.

(7) Database has been developed for the Study to support planning and future O & M activities of the responsible organizations as one of the supporting tools.

(8) The Master Plan is to be formulated and priority projects are selected after assessing the existing conditions from technical, social, economic and environmental aspects.

(9) For effective technical transfer daily on-the-job training and periodical technical meetings together with technical seminars and workshops are planned and have been conducted. The workshops and technical seminars conducted are outlined and shown in *Annex-1.1* to *Annex 1.3*.

1.3 IMPLEMENTING AGENCIES

The implementing agency (or counterpart agency) for the Study is the Department of Public Works and Highways (DPWH). In the I/A, it was agreed that the Metropolitan Manila Development Authority (MMDA) would be the main implementing agency and DPWH would be the support agency. However, MMDA could not be the implementing agency for the Study and so the National Economic and Development Authority (NEDA) decided that DPWH would be the main implementing agency. Thereafter, DPWH assigned members of the Counterpart Team, and organized the Steering Committee and the Technical Working Group for the Study and has stood as the main implementing agency during the Study.

1.4 PARTICIPANTS

The participants for the Study are as follows:

- JICA Study Team and DPWH counterpart team
- Steering Committee
- Technical Working Group

In addition, JICA organized for the Study an advisory committee in Japan. Members of each organization and staff are listed and shown in *Annex 1.4* to *Annex 1.7*.

MMDA and the Local Government Units (LGUs) concerned have assigned responsible support staff for the Study as well.

Annex 1.1: Public Participation Workshop

Main Target Group: Concerned Government and Non-Government Organizations

No.	Date	Time	Venue	Number of Participants	Contents
1	March 10, 2004	9:00 - 17:30	Philippine Trade Training Center	66	- To understand and appreciate the Study - To identify the concerns, problems/issues on drainage
2	May 21, 2004	8:00 - 17:00	Philippine Trade Training Center	65	- To discuss the present state of the structural, non-structural and supporting measures for drainage improvement - To propose the structural, non-structural, and supporting measures
3	July 22, 2004	8:00 - 17:00	Philippine Trade Training Center	57	- To analyze the major factors that influence the successful implementation of the project using S.W.O.T. analysis
4	October 1, 2004	8:00 - 17:00	Traders Hotel, Manila	72	- To develop and prepare the LGU Operation/Maintenance guidelines for priority projects
5	January 19, 2005	8:00 - 17:00	Traders Hotel, Manila	49	- To classify the O & M as activities for pre-construction, construction and operation - To identify the responsible agency and its specific role during each stage - To prepare the guidelines for the monitoring of the O & M
6	March 2, 2005	8:00 - 17:00	Traders Hotel, Manila	106	- To elicit reactions and comments about the final result of the Study - To discuss how the proposed project from the Study could be incorporated into the LGU's Development Plan.

Annex 1.2: Barangay Cluster Workshop

Main Target Group: Barangays Affected by the Project

No.	Date	Time	Venue	Number of Participants	Contents
1	July 23, 2004	8:00 - 17:00	Bayview Park Hotel, Manila	43	- To analyze the major factors that influence the successful implementation of the project using S.W.O.T. analysis
2	October 22, 2004	8:00 - 17:00	Traders Hotel, Manila	166	- To develop and prepare the Barangay Operation/Maintenance guidelines for priority projects
3	January 20, 2005	8:00 - 17:00	Traders Hotel, Manila	109	- To classify the O & M as activities for pre-construction, construction and operation - To identify the responsible agency and its specific role during each stage - To prepare the guidelines for the monitoring of the O & M

Annex 1.3: Technical Seminar

Main Target Group: Concerned Government and Non-Government Organizations

No.	Date	Time	Venue	Number of Participants	Contents
1	May 19, 2004	8:00 - 17:00	Bayview Park Hotel, Manila	53	- Study Approach /Methodology and Finding and Observation ・ Drainage System Assessment ・ Hydrological/Hydraulic Analysis ・ Drainage Planning ・ Solid Waste Management
2	January 18, 2005	8:00 - 17:00	Traders Hotel, Manila	47	- Drainage and Solid Waste Management in Japan - Result and Output of the Study ・ Database ・ Existing Condition of Drainage System ・ Drainage Improvement Plan

ANNEX 1.4: JICA ADVISORY COMMITTEE AND JICA STUDY TEAM

JICA Advisory Committee

Name	Position	Affiliation
Nobuhisa TAKEDA	Chairman of Advisory Committee	Senior Advisor (Public Participation) Japan International Cooperation Agency
Takaaki KUSAKABE	Member of Advisory Committee	Senior Research Fellow (Flood Control) National Institute for Land and Infrastructure Management Ministry of Infrastructure, Land and Transportation
Kazuhiko KOMINE	Member of Advisory Committee	Senior Engineer (Urban Drainage and Sewerage) Department of Sewerage Fukuoka City

JICA Study Team

Name	Assignments
Hajime TANAKA	Team Leader
Takayuki NOBE	Deputy Team Leader / Drainage Planning (1)
Akinori SATO	Deputy Team Leader / Environment / Solid Waste Management
Tadanori KITAMURA	Drainage Planning (2) / Hydraulics
Ryosaku NAGATA	Drainage Facility Design
M. M. Sabbir Hassan	Hydrological and Hydraulic Modeling
Akio ISHII	Solid Waste Analysis
Sonoe YAMADA	Social Issue / Public Participation (1)
Felixberto Hansen Roquia, Jr.	Public Participation (2)
Tsutomu KAMEYAMA	Operation and Maintenance
Kenji MORITA	Database
Hidemaro SAIGA Toshiro IWAHASHI	Construction Planning / Cost Estimation
Shingo SATO	Economics / Finance

ANNEX 1.5: COUNTERPART TEAM

Name	Designation	Office	Responsibility
Napoleon S. Famadico	Engineer IV	DPD-PS	Team Leader
Orlando M. Casio	Engineer III	DPD-PS	Deputy Team Leader Drainage Planning
Jesus O. Averilla	Sr.Env'I.Plng.Sp.	DPD-PS	Deputy Team Leader Env't Solid Waste Management
Leonila Mercado	Engineer IV	PMO-MFCP	Coordinator Drainage Planning, Hydraulics
Elmo F. Atillano	Engineer III	DPD-PS	Hydrological and Hydraulic Modeling
Marceline G. Tolentino, Jr.	Engineer III	DPD-PS	Drainage Facility Design
Manuel M. Leano		PMO-MFCP	Solid Waste Analysis
Leonardo P. Sanchez		NCR	Social Issue/Public Participation (1)
Joselito B. Manoos		NCR	Public Participation (2)
Myrna M. Rodriguez		NCR	Social Issues/Relocation
Aquilina T. Decilos	Engineer III	DPD-PS	Const'n Planning/Cost Estimation
Diana Parubrub	Data Encoder	DPD-PS	Database
Silverio Auxtero	Engineer Asst.	DPD-PS	Operation and Maintenance
Estelita M. Leonado	Economist III	DPD-PS	Economics/Finance

ANNEX 1.6: STEERING COMMITTEE

	Name	Designation	Office	Responsibility
1	Manuel M. Bonoan	Undersecretary	DPWH	Chairman
2	Cesar Lacuna	Deputy Chairman	MMDA	Co-Chairman
3	Ruben S. Reinoso, Jr	Asst. Director General	NEDA	Member
4	Percival C. Chavez	Chairperson	PCUP	Member
5	Rolu P. Encarnacion	Weather Service Chief	PAGASA	Member
6	Lailani C. Basig	Project Officer II	HUDCC	Member
7	Ma. Alma T. Valencia	Deputy Manager	NHA	Member
8	Alicia R. Bala	Regional Director	DSWD	Member
9	Leonor C. Cleopas	Manager	MWSS	Member
10	Resito David	Project Director	PMO-FCSEC	Member
11	Toshiyuki KANO	JICA Advisor	PMO-FCSEC	Member
12	Akito KAGAWA	JICA Expert	DPWH	Member *(- May 2004)*
13	Shunta DOZONO	JICA Expert	DPWH	Member *(June 2004 -)*
14	Jejomar C. Binay	City Mayor	Makati City	Member
15	Jose L. Atienza	City Mayor	Manila City	Member
16	Wenceslao B. Trinidad	City Mayor	Pasay City	Member
17	Feliciano R. Belmonte	City Mayor	Quezon City	Member
18	Sigfrido R. Tinga	City Mayor	Taguig City	Member
19	Enrico Recom Echiverri	City Mayor	Caloocan City	Member

ANNEX 1.7: TECHNICAL WORKING GROUP

	Name	Designation	Office	Responsibility
1	Patrick Gatan	Project Director	DPWH-PMO-MFCP 1	Head
2	Vernon M. Espiritu	Planning Officer IV	MMDA	Co-Head
3	Alejandro F. Salvador	Principal Engineer	NEDA	Member
4	Resito V. David	Project Director	PMO-FCSEC	Member
5	Gerome M. Dela Rosa	Assistant Director	NCR	Member
6	Gilberto S. Reyes	Assistant Director	BOD	Member
7	Camilo G. Foronda	Office-in-Charge	Legal Service	Member
8	Mario G. Navarro	Project Manager II	PMO-MFCP I	Member
9	Dolores Hipolito	Project Manager II	PMO-FCSEC	Member
10	Rebecca T. Garsuta	Engineer V	Planning Service	Member
11	Nelson A. Morales	City Engineer	Makati City	Member
12	Armando L. Andres	City Engineer	Manila City	Member
13	Edwin Y. Javaluyas	City Engineer	Pasay City	Member
14	Joselito B. Cabungkal	City Engineer	Quezon City	Member
15	Rolando D. Eduria	City Engineer	Caloocan City	Member
16	Marcelo M. Sertajuan	City Engineer	Taguig City	Member

2. CHARACTERISTICS OF STUDY AREA

2.1 NATURAL CONDITIONS

(1) Topographic Conditions

The west boundary of the study area is the coastline along Manila Bay, except for the newly developed reclamation area. On the other hand, there are mainly hilly zones along the east, north and south boundaries as shown in *Figure S.2.1*. Those boundaries are determined fundamentally based upon natural drainage basins. The highest elevation within the study area is about 40 m above the Mean Sea Level (MSL), whereas the lowest is same as the MSL. About 60% of the study area is lower than 4 m above the MSL, which has mild slope.

The hilly areas are formed by a ridge of volcanic tuff (the Guadalupe tuff), locally called "adobe". The low-lying area is filled with recent fluvial deposits of sand, silt, gravel and clay, which have been conveyed mainly by the Pasig River and other small rivers.

(2) Supplementary Topographic Survey

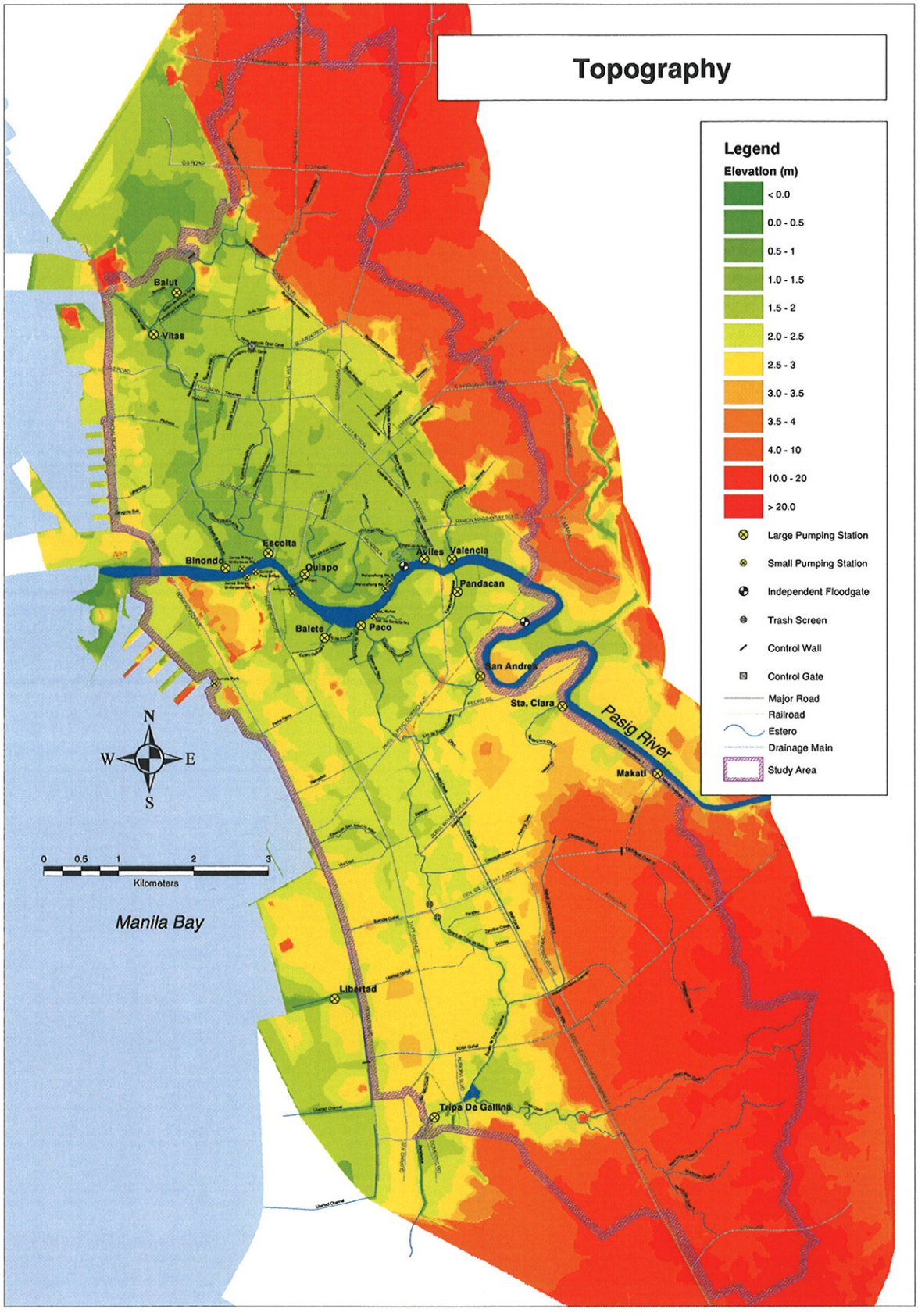
During the Study supplementary longitudinal and cross-sectional surveys on esteros/creeks have been conducted to support the available data for the Study. The benchmarks applied in the last JICA study in 2000 (the Study on the Existing Laterals in Metro Manila: SEDLMM) have been checked based on BM-ML3, which is located at Quezon City, and used as the primary benchmark for the digital topographic map (1:5000) prepared by the JICA study (the Earthquake Impact Reduction Study for Metropolitan Manila: MMEIRS) based on the aerial photographs (1:10000) in 2004.

(3) Current Land Subsidence

The land subsidence in Port Area is estimated at about 0.5 m after 1960. The rate of subsidence was very high in 1964-1979—about 0.4 m within 15 years (0.027 m/year). During that period, amount of groundwater extraction was also very large. It indicates that large amount of groundwater extraction could be one of the causes of land subsidence. During 1980-1990, the rate of land subsidence was low compared to that in 1964-1979—about 0.1 m within 10 years (0.01m/year). This is probably because of significant reduction of groundwater extraction.

The elevation of BM-66 located in Port Area, Manila in 2004 is about 0.13 m lower than that in 1978, which indicates that the rate of land subsidence around Port Area is about 0.13 m within the last 26 years (0.005 m/year). This fact supports the conclusion that the rate of land subsidence around Port Area has been decreasing and will be decreasing.

The spatial distribution of land subsidence in the core area is not clear because there is not enough information and the effect of future land subsidence in the core area is not included in the drainage planning. In the Study, the ground elevations are updated to the most recent one, and those updated elevations are employed to formulate the drainage improvement plan.



Source: JICA Study Team (2004)

Figure S.2.1 Elevation Contour

(4) Monitoring Networks on Meteo-Hydrology

There are four rainfall stations in and around the study area: Port Area, Science Garden, NAIA and Napindan. Available rainfall data and general climatic data at all the above-mentioned four stations have been collected during the Study.

There are three water level stations located along the Pasig River within the reach of the study area, namely Fort Santiago, Pandacan and Napindan.

Annual average rainfall at Port Area, Science Garden, NAIA and Napindan stations are calculated at 2,171 mm, 2,483 mm, 1,836 mm and 2,050 mm, respectively. Over the study area, annual average rainfall is calculated at 2,125 mm.

Maximum rainfall over the study area occurs in the month of July (475 mm) and then in the month of August (425 mm). It can be seen that 81% of the annual total rainfall over the study area falls during the months of June to October, which can be called as Wet Season.

2.2 SOCIO-ECONOMIC CONDITIONS

(1) Land use – Development Trend and Existing Conditions

In terms of land use in Metropolitan Manila, in 1986 developed land was 50.4%, transformable land was 36.2% and unusable land was 13.2%. After that, at least half of the transformable land in 1986 was developed for the increasing population based on the estimation of land use change.

Among the existing land use in the study area, residential use occupies the most at 48%. Commercial use follows at 16% and Industrial use at 7%. Forestland is just at 2ha and there is no agricultural land use in the study area.

(2) Daily Person Trip in Metropolitan Manila

Generally, people prefer to travel shorter distances and to seek employment near their residences. However, this has not always been possible because of expansion of urban area and suburban sprawl, and there are evidences of growing cross-town trips in Metropolitan Manila. The cities of Manila and Makati attract traffic from all over Metropolitan Manila. This implies that the traffic disturbance would affect thousands of people at the present day when flood and inundation occur in the study area.

(3) LGUs and Barangay

The study area (73.4 km^2) consists of six LGUs: Caloocan, Manila, Quezon, Pasay, Makati, Taguig and 1,199 barangays as follows:

Table S.2.1 Number of Barangays in the Study Area

	Metropolitan Manila	Caloocan	Manila	Quezon	Pasay	Makati	Taguig
Study Area (Master Plan)	1,199	119	848	18	190	22	2
Total Area	1,694	188	897	142	201	33	18

Source: Census 2000, National Statistics office (NSO)

(4) Population

Based on the latest Population Census in 2000 conducted by the National Statistics Office (NSO), Metropolitan Manila has a total population of 9,932,560. The top three LGUs in terms of total population are the cities of Quezon, Manila, and Caloocan.

While the population in Metropolitan Manila continues to grow, the study area as the core area of Metropolitan Manila shows different trends recently. Although populations of Caloocan, Quezon and Taguig are growing, that of Makati has stopped, and Manila and Pasay populations are declining after 1995. This trend is regarded as a suburban sprawl phenomenon in Metropolitan Manila.

Table S.2.2 Population, 2000 / 1995 / 1990

LGU	Population			Population Growth	
	2000	1995	1990	95-00	90-95
NCR (Metropolitan Manila)	9,906,048	9,454,040	7,948,402	0.94%	3.53%
City of Manila	1,581,082	1,654,761	1,601,234	*-0.91%*	0.66%
City of Makati	444,867	484,176	453,170	*-1.68%*	1.33%
Caloocan City	1,177,604	1,023,159	763,415	2.85%	6.03%
Pasay City	354,908	408,610	368,366	*-2.78%*	2.10%
Quezon city	2,173,831	1,989,419	1,669,776	1.79%	3.57%
Taguig City	467,375	381,350	266,637	4.15%	7.42%

Source: MMEIRS, National Statistics Office, 2002, compiled by JICA Study Team

(5) Informal Settlers

According to the UN-Habitat report, informal settlements can be found in 526 communities, accounting for some 2.54 million located in all the cities and municipalities of Metropolitan Manila. Current data on the number of informal settlers are derived from surveys conducted by the Housing and Urban Development Coordinating Council (HUDCC).

Table S.2.3 Number of Households and Number of Informal Settlers, 2002

	Total Households	Depressed HHs (Informal Settlers)	% of Total
City of Manila	333,547	99,549	29.8
Quezon City	480,624	169,490	35.2
Caloocan City	249,567	67,292	26.9
Makati City	98,225	27,024	27.5
Pasay City	78,180	57,436	73.4
Municipality of Taguig	102,723	21,931	21.3

Source: HUDCC unpublished report, 2002,
Urban Slums Reports: The case of Manila, Philippines, UN-Habitat, 2003

According to the analysis made by the use of the aerial photograph by MMEIRS (JICA Study), the estimated total buildings intruding into esteros in the core area is about 2,100 and *Figure S.2.2* shows the distribution of severity of encroachment into esteros together with the estimated number of buildings within esteros. The total households are estimated at 6,000.

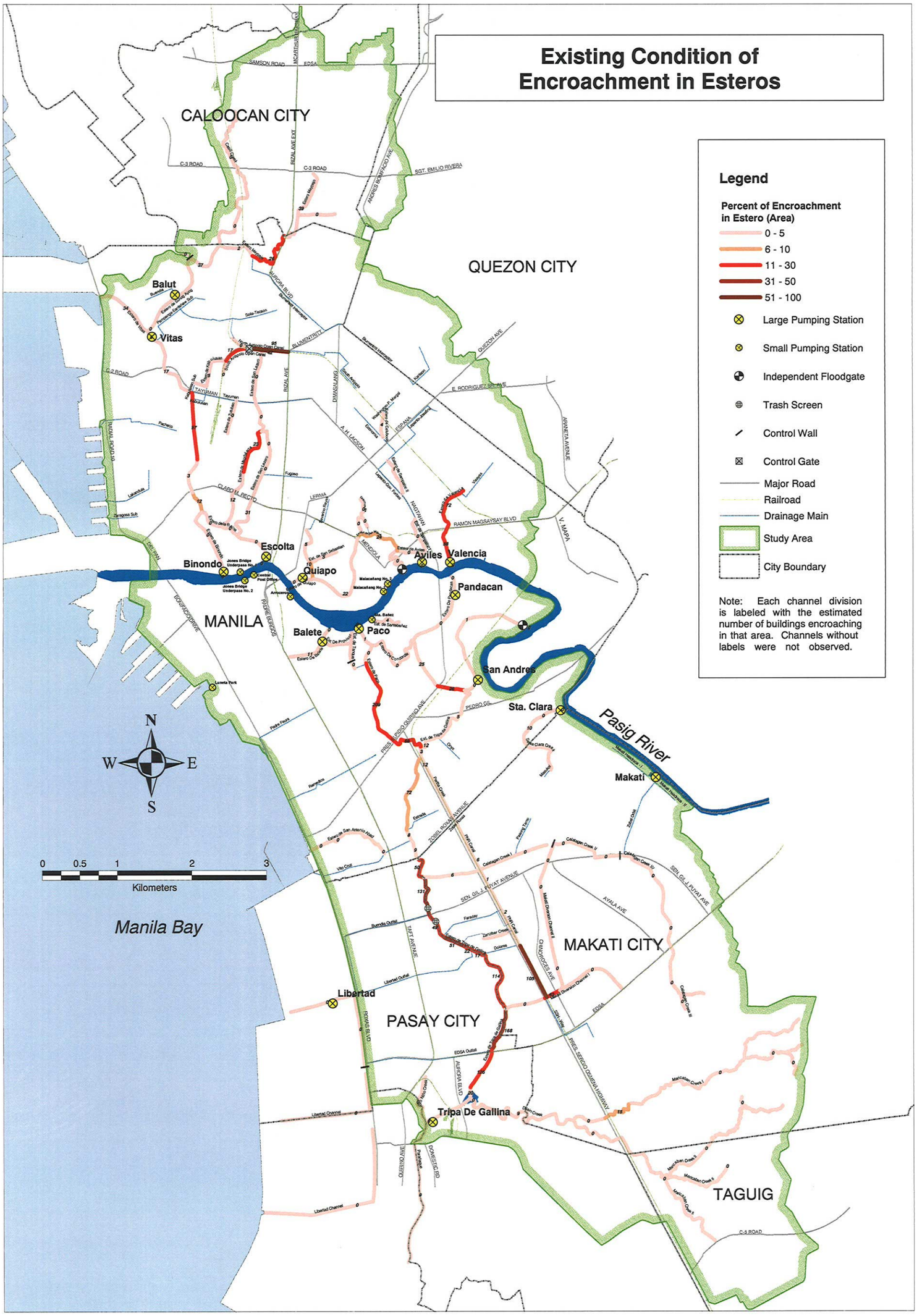


Figure S.2.2 Encroachment within Esteros

2.3 FLOOD AND INUNDATION

(1) Inundation in 1999

The flood and inundation occur frequently in the core area. The inundation in 1999 is one of the current severe flood and inundation in the core area. The inundation conditions (depth and duration) were surveyed by the JICA Study in 2000 (SEDLMM).

According to the meteo-hydrological data on the floods in 1999, heavy rainfalls were recorded on August 2-3, September 10-11 and October 16-17, at two stations: Port Area and Science Garden, in and around the study area. Tidal levels at Manila South Harbor were quite high during these periods. The rainfall depths at the two stations are shown as follows:

- At Port Area maximum 24-hour rainfall depths measured 232 mm, 125 mm and 190 mm in August, September and October, which correspond to 6-year, <2-year, and 3-year return periods, respectively.
- At Science Garden, maximum 24-hour rainfall depths were 281 mm, 224 mm, 152 mm in August, September and October, which correspond to 12-year, 4-year and <2-year return periods, respectively.

(2) Inundation Conditions

Figures S.2.3 and S.2.4 show the inundation depth, duration and the severe inundation areas in the 1999 flood at both North Manila and South Manila.

The maximum inundation depth recorded is around 1.3 m, which occurs along España Street in North Manila, and the area in which the inundation is deeper than 0.5 m extends widely in the central part of North Manila. In the area inundation duration exceeds 24 hours. In South Manila, deep inundation occurs along the east side of the PNR canal and along the Estero de Tripa de Gallina. In the area inundation duration is less than 12 hours.

The severe inundation areas identified are as follows:

- North Manila: Aviles-Sampaloc area in the Quiapo-Aviles, Vitas-Binondo-Escolta and Maypajo-Blumentritt-Balut drainage blocks
- South Manila: San Isidro-San Antonio-Pio del Pilar area in the Libertad-Tripa de Gallina drainage block

According to the Study on the inundation area of the flood in 1999, the inundation affected 1.24 million people, 97,000 houses and about a half of the roads and streets in the core area.

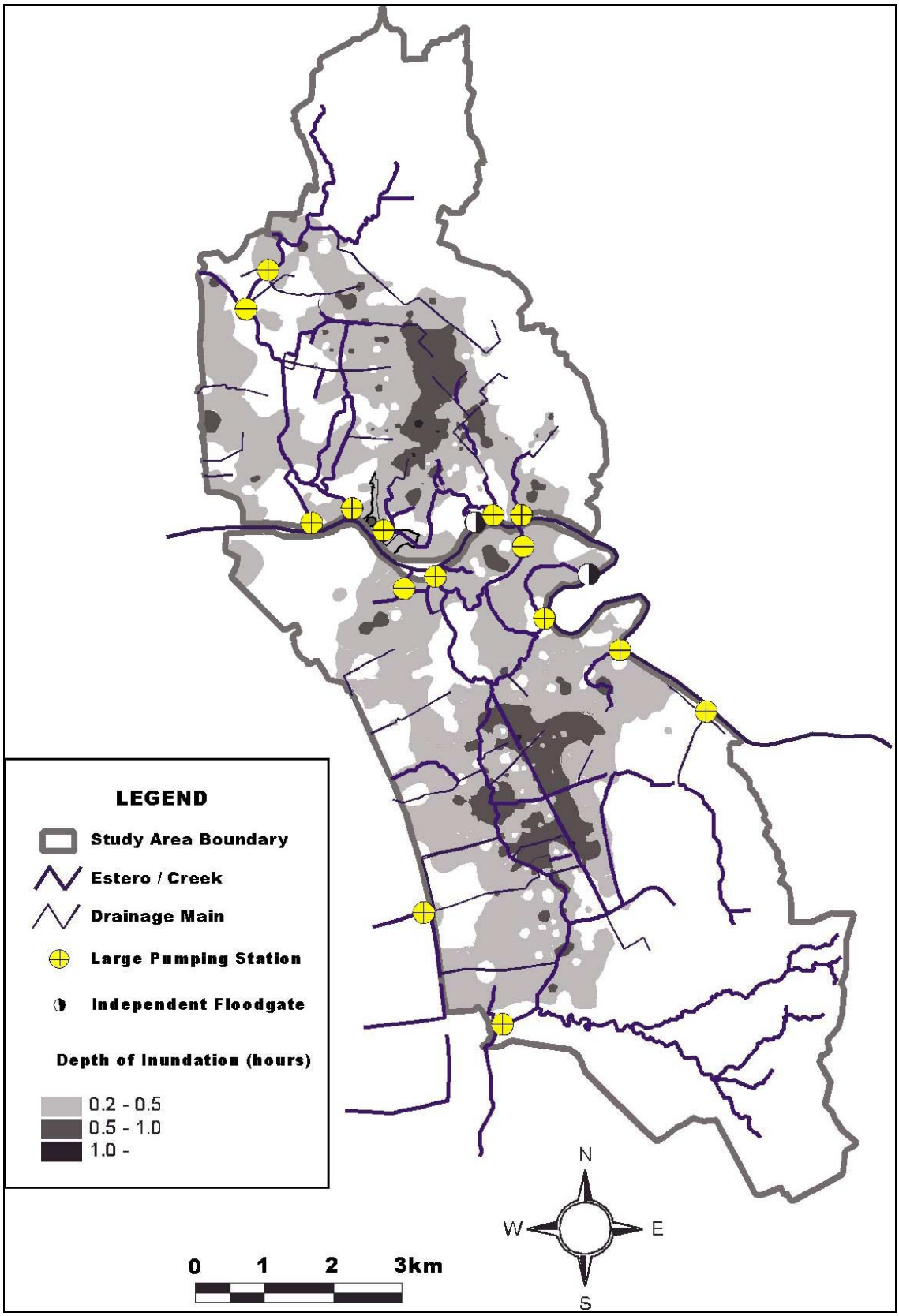


Figure S.2.3 Maximum Depth in 1999 Inundation

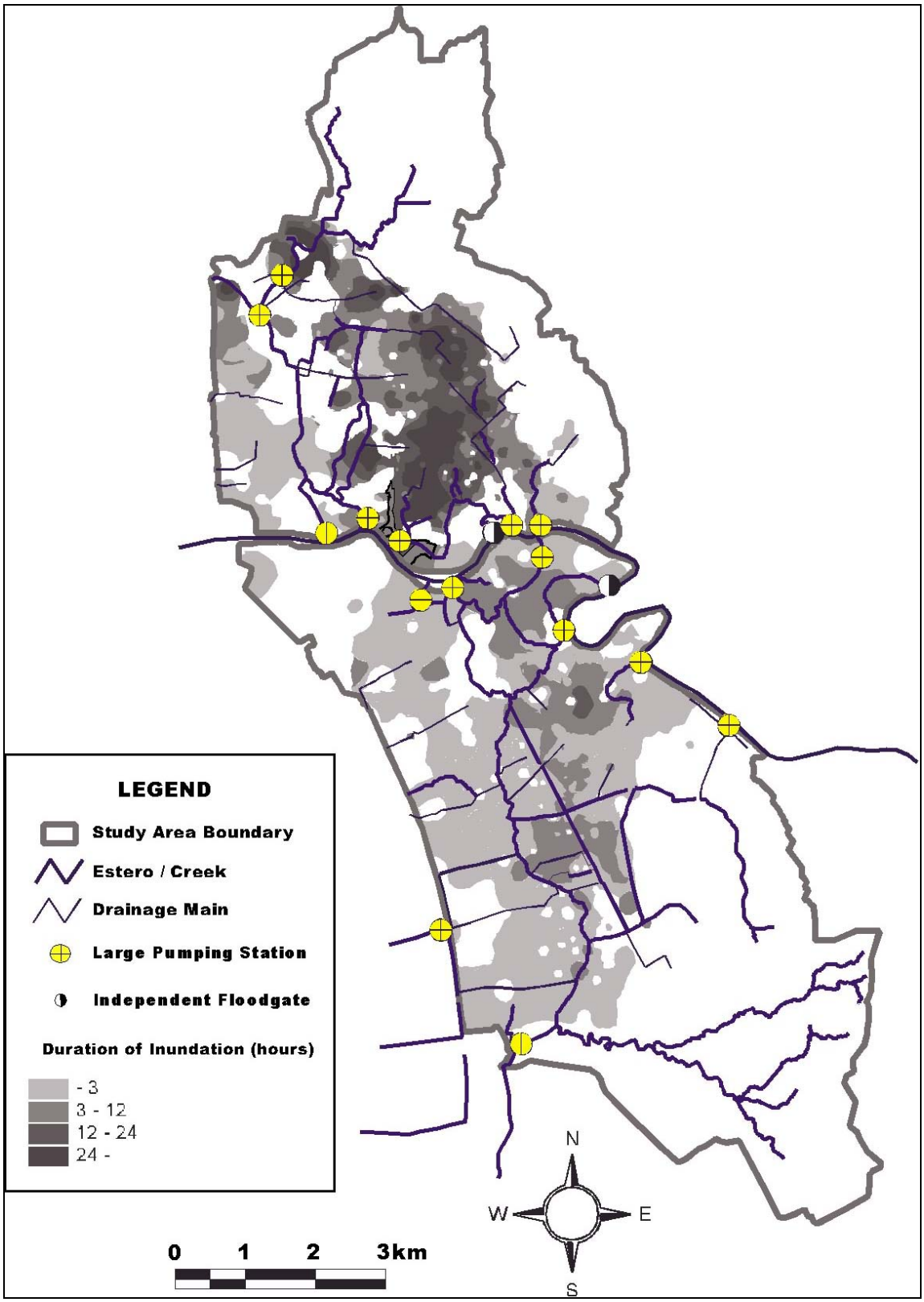


Figure S.2.4 Duration in 1999 Inundation

According to the inundation depth along the major roads in the core area, streets inundated every year are as follows:

North Manila:

- España St., Sampaloc
- Maceda St., Sampaloc
- Rizal Avenue, Sta. Cruz
- C.M. Recto Avenue

South Manila

- Batangas St., Makati
- Magallanes Interchange, Makati
- Roxas Boulevard, Pasay

The flood and inundation cause various adverse impacts not only on the inundation area but also on the surrounding area. The severe inundation affects the socio-economic activities in the capital area by causing severe traffic congestions and disturbing business and people's trip to offices and schools, and giving the inundation areas unhealthy living conditions that could lead to illness and deaths. Various cases of diseases and sickness after the occurrence of floods are reported.

(3) Causes of Severe Inundation Area

1) North Manila

Aviles-Sampaloc area suffers from frequent and severe regional inundation, which is caused by not only local stormwater in Quiapo-Aviles drainage block but also the excess stormwater from the hilly area of Blumentritt interceptor's basin. The problems are summarized as follows:

- The flow capacity of the existing Blumentritt interceptor is very small compared to its drainage basin,
- The existing Blumentritt interceptor is not able to collect and discharge the stormwater from its own basin and the stormwater overflowed enters into the drainage basin of Vitas-Binondo-Escolta drainage block,
- The overflowed stormwater from the existing Blumentritt interceptor's basin is drained into the Pasig River through Aviles and/or Quiapo pumping stations, and
- To make the situation worse, the capacity of Severino Reyes drainage main, a secondary channel connected to Quiapo pumping station, is not large enough.

2) South Manila

San Isidro-San Antonio-Pio del Pilar area, which is drained by the drainage channels: Zobel-Roxas, PNR canal, Calatagan creek I, Faraday drainage main, Makati Diversion Channel, etc. in Libertad-Tripa de Gallina drainage block, is suffering from inundation frequently. The causes of the severe inundation are simply the lack of drainage capacities of the drainage channels. In order to solve the inundation problems, rehabilitation of the existing drainage channels (Estero de Tripa de Gallina and others) by dredging and declogging as well as remedial works and additional drainage facilities are required.

2.4 DRAINAGE

(1) Drainage Facilities and Drainage Blocks

The core area is mostly low-lying and about 70% (52 km²) of the core area's stormwater has to be drained by pumps.

The study area is divided by the Pasig River into two areas: North Manila (right bank of the Pasig River) and South Manila (left bank of the Pasig River). In the core area there are 15 major drainage pumping stations, 74 km of esteros/creeks and 35 km of drainage mains/outfalls and about 400 km laterals, which are divided into 11 drainage blocks. The drainage facilities and drainage blocks of North Manila and South Manila are summarized in *Table S.2.4* and are shown in *Table S.2.5* and *Figures S.2.5*.

Table S.2.4 Summary of Drainage Facilities

North Manila: *5 drainage blocks (28.78 km^2)*	*South Manila:* *6 drainage blocks (43.80 km^2)*
Consisting of:	*Consisting of:*
7 large pumping stations	*8 large pumping stations*
3 small pumping stations	*5 small pumping stations*
20 esteros/creeks: 27.78 km	*22 esteros/creeks: 45.72 km*
19 drainage mains/outfalls: 17.78 km	*18 drainage mains/outfalls: 17.00 km*

The existing major drainage pumping stations have mostly become old and need rehabilitation, and the existing drainage channels: esteros/creeks and drainage mains/outfalls, have lost their original (or design) capacities due to illegal activities: dumping of solid waste into the drainage channels and numerous informal house buildings/structures in drainage channels.

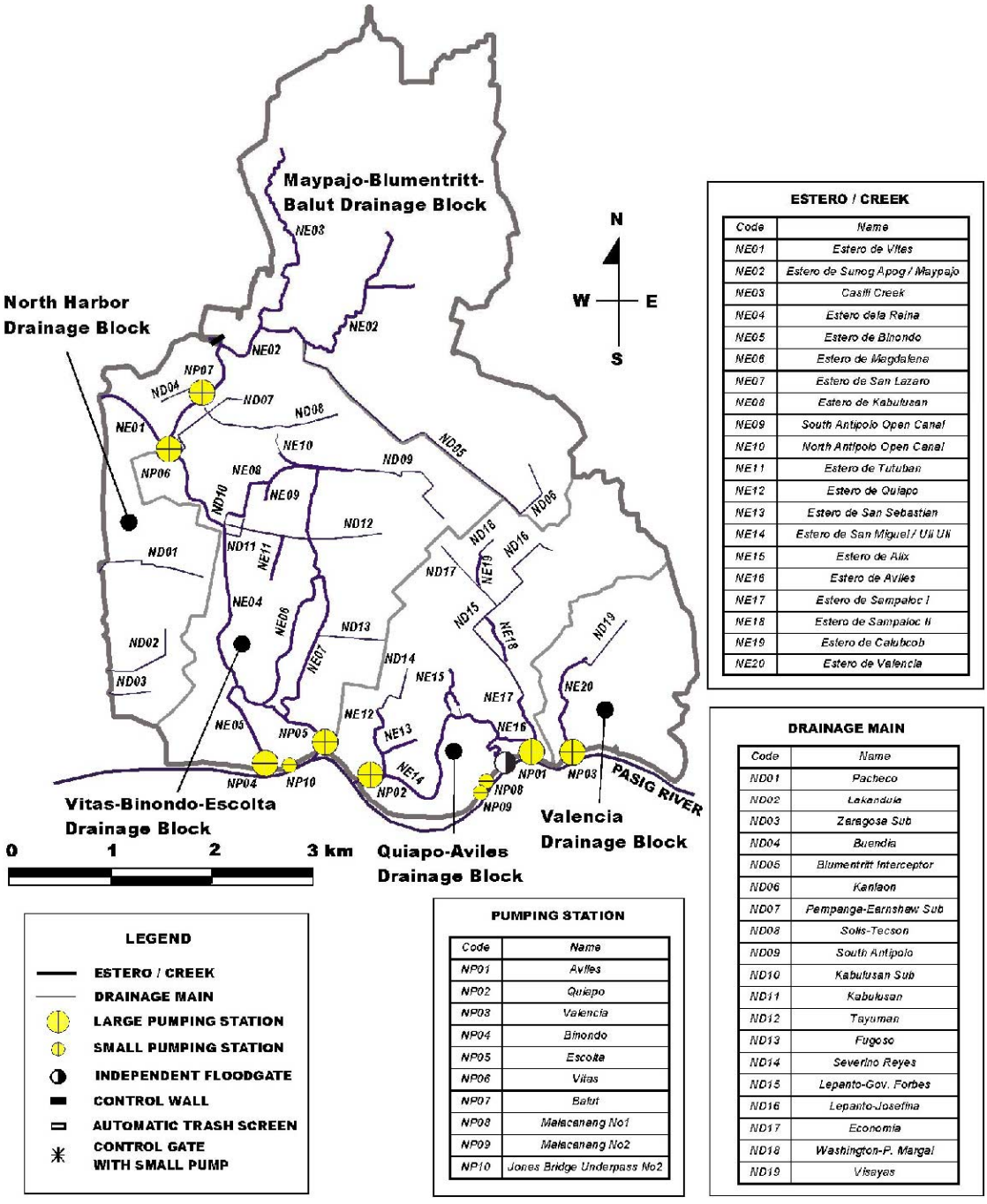
The volume of dumped bottom deposits: solid waste and silt, is estimated to be about 920,000 m³ and the informal house buildings/structures and households in drainage channels are estimated to be 2,100 and 6,000.

The drainage improvement requires measures as follows:

- To rehabilitate (or improve) the major drainage pumping stations,
- To recover the original (or design) drainage capacities of the existing drainage channels by dredging and declogging,
- To improve the drainage system of the severe inundation areas with remedial works and/or additional facilities to be able to meet the current runoff conditions,
- To improve the O & M organization and activities for drainage facilities,
- To remove or relocate informal house buildings in drainage channels,
- To involve barangay communities for O & M activities for drainage, and
- To involve barangay communities for solid waste collection.

Table S.2.5 (1) Major Dimensions of Each Drainage Block in North Manila

ID	*Name of Drainage Block*	*Area (km^2)*	*Total Length of Esteros /Creeks (km)*	*Total Length of Drainage Mains (km)*
N01	*Vitas-Binondo-Escolta*	*8.55*	*13.14*	*6.62*
N02	*Quiapo-Aviles*	*5.58*	*6.77*	*3.90*
N03	*Valencia*	*2.37*	*1.22*	*0.67*
N04	*Maypajo-Blumentritt-Balut*	*9.91*	*6.65*	*4.13*
N05	*North Harbor*	*2.37*	*0.00*	*2.46*
	Total	*28.78*	*27.78*	*17.78*



ESTERO / CREEK

Code	Name
NE01	Estero de Vitas
NE02	Estero de Sunog Apog / Maypajo
NE03	Casili Creek
NE04	Estero dela Reina
NE05	Estero de Binondo
NE06	Estero de Magdalena
NE07	Estero de San Lazaro
NE08	Estero de Kabutusan
NE09	South Antipolo Open Canal
NE10	North Antipolo Open Canal
NE11	Estero de Tutuban
NE12	Estero de Quiapo
NE13	Estero de San Sebastian
NE14	Estero de San Miguel / Uli Uli
NE15	Estero de Aux
NE16	Estero de Aviles
NE17	Estero de Sampaloc I
NE18	Estero de Sampaloc II
NE19	Estero de Calubcob
NE20	Estero de Valencia

DRAINAGE MAIN

Code	Name
ND01	Pacheco
ND02	Lakandula
ND03	Zaragosa Sub
ND04	Buendia
ND05	Blumentritt Interceptor
ND06	Kanlaon
ND07	Pampanga-Earnshaw Sub
ND08	Solis-Tecson
ND09	South Antipolo
ND10	Kabutusan Sub
ND11	Kabutusan
ND12	Tayuman
ND13	Fugoso
ND14	Severino Reyes
ND15	Lepanto-Gov. Forbes
ND16	Lepanto-Josefina
ND17	Economia
ND18	Washington-P. Margal
ND19	Visayas

PUMPING STATION

Code	Name
NP01	Aviles
NP02	Quiepo
NP03	Valencia
NP04	Binondo
NP05	Escolta
NP06	Vitas
NP07	Balut
NP08	Malacanang No1
NP09	Malacanang No2
NP10	Jones Bridge Underpass No2

Figure S.2.5 (1) Drainage System in North Manila

Table S.2.5 (2) Major Dimensions of Each Drainage Block in South Manila

ID	*Name of Drainage Block*	*Area (km^2)*	*Total Length of Esteros /Creeks (km)*	*Total Length of Drainage Mains (km)*
S01	*Libertad-Tripa de Gallina*	*25.96*	*29.80*	*11.02*
S02	*Balete*	*0.94*	*0.55*	*0.00*
S03	*Paco-Pandacan-San Andres*	*6.12*	*10.59*	*1.10*
S04	*Sta. Clara*	*1.57*	*1.49*	*0.13*
S05	*Makati*	*4.31*	*2.56*	*2.24*
S06	*South Harbor and Others*	*4.90*	*0.73*	*2.51*
	Total	*43.80*	*45.72*	*17.00*

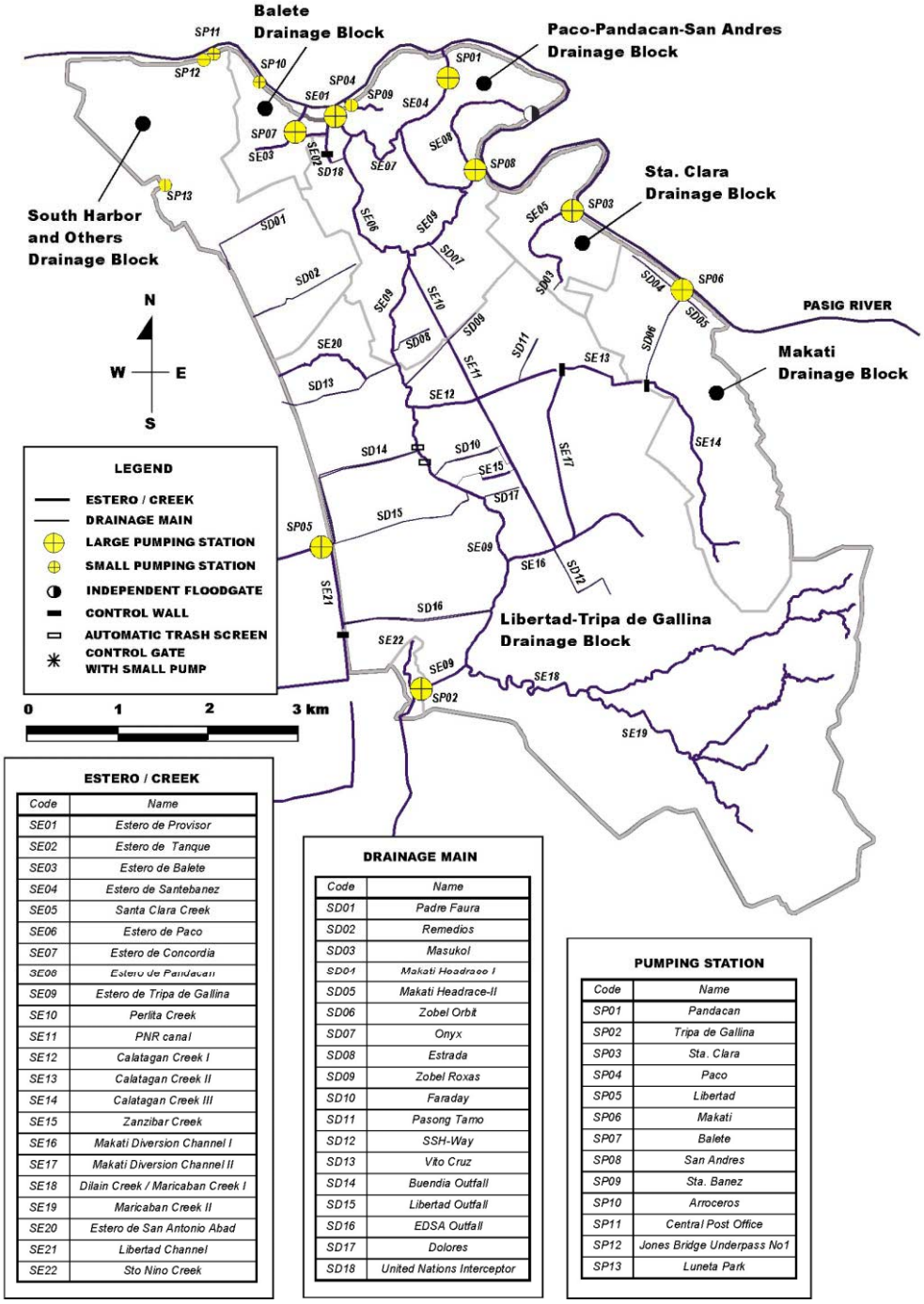


Figure S.2.5 (2) Drainage System in South Manila

(2) Drainage Pumping Station

The major drainage pumping stations are fundamental drainage facilities in the core area. The existing 15 major drainage pumping stations are designed independently to drain each of the pump drainage basins, but most of the pump drainage basins are connected by drainage channels and are not independent instead of their design. The existing conditions of pump drainage basins are explained as follows:

North Manila:

- Vitas, Binondo and Escolta pumping stations are jointly operating through Estero de Vitas, Binondo and Reina.
- Quiapo and Aviles are jointly operating through Estero de San Miguel and Aviles.

South Manila:

- Libertad, Tripa de Gallina, and Paco-Pandacan-San Andres drainage basins are jointly drained through Estero de Tripa de Gallina.

The capacity of each drainage pumping station is shown in the following table.

Table S.2.6 Total Drainage Capacity and Area of Drainage Basin for Large Pumping Stations

Basin_ID	*Name of Pumping Station*	*Drainage Area*[*1] *(km^2)*	*Capacity (m^3/s)*	*Specific Discharge ($m^3/s/km^2$)*
N01_01	*Vitas*	*5.56*	*32.0*	*5.76*
N01_02	*Binondo*	*2.69*	*11.6*	*4.31*
N01_03	*Escolta*	*0.30*	*1.5*	*5.07*
N02_01	*Quiapo*	*2.29*	*10.8*	*4.71*
N02_02	*Aviles*	*3.28*	*15.6*	*4.75*
N03_01	*Valencia*	*2.37*	*11.8*	*4.98*
N04_02	*Balut*	*0.49*	*2.0*	*4.05*
S01_01	*Tripa de Gallina*	*17.05*	*57.0*	*3.34*
S01_02	*Libertad*	*7.48*	*42.0*	*5.61*
S02_01	*Balete*	*0.94*	*3.0*	*3.19*
S03_01	*Paco*	*1.74*	*7.6*	*4.37*
S03_02	*Pandacan*	*1.15*	*4.4*	*3.84*
S03_03	*San Andres*	*3.23*	*19.0*	*5.88*
S04_01	*Sta. Clara*	*1.57*	*5.3*	*3.38*
S05_01	*Makati*	*1.65*	*7.0*	*4.24*

Note:

[*1] Based upon the review by JICA Study Team

[*2] Drainage boundary of Tripa de Gallina and Libertad is quite unclear. Stormwater in this drainage area is actually drained by the combined efforts of the two pumping stations.

Major design conditions of the above drainage pumping stations are as follows.

- Design flood scale: 10-year stormwater
- Operating system: Electric power by MERALCO with diesel engines
- Solid waste treatment: Automatic trash removal equipment
- Drainage gate: Gate for gravity drainage
- Total drainage capacity: 230.6 m^3/s
- Total service area: 51.80 km^2
- Average unit drainage capacity per km^2: 4.45 $m^3/s/km^2$

The 10 pumping stations among them have already been operating for 20-30 years, and have remarkable problems such as deterioration of casing liner, erosion and corrosion of guide casing, and crack of various major parts and engine units, and require urgent action for their rehabilitation.

2.5 O & M FOR DRAINAGE FACILITIES

(1) Existing O & M Organization for Drainage

The responsibility of the flood control section of DPWH was partly transferred to MMDA in August 2002 and the O & M activities of the major drainage pumping stations have been transferred to MMDA.

MMDA is also responsible for the O & M of drainage system in the core area and LGUs are responsible for laterals along the secondary roads. Under the flood control management service of MMDA, Pumping Stations and Floodgate Operation (PSFO), Drainage and Waterways Operation (DWO) and Equipment Support Group, have O & M activities for the drainage system.

(2) O & M for Drainage Pumping Station

PSFO manage the operation of drainage pumping stations and the solid waste collection at the drainage pumping stations.

1) Locally Different Operation Hours

The operation status is different among the 15 drainage pumping stations. The annual operation hours are increasing specifically at 6 pumping stations: Aviles, Quiapo, Valencia, Tripa de Gallina, Libertad, Binondo and Balete. The operation hour of each pumping station is shown in the following table.

Table S.2.7 Operation Status and Operating Hours

Pumping Station	Year	Pump No. 1	2	3	4	5	6	7	8
Pandacan	1976	○ 219	○ 197						
Aviles	1976	○ 702	○ 763	○ 670	○ 643				
Quiapo	1976	● 465	● 467	○ 387	○ 588				
Valencia	1976	● 582	● 510	● 410	● 374				
Tripa de Gallina	1977	● 712	● 662	● 712	● 71	● 175	● 20	● 13	● 35
Sta. Clara	1977	○ 219	○ 209						
Paco	1977	● 312	● 175	● 783					
Libertad	1982	● 440	○ 875	● 496	○ 170	● 168	○ 258		
Makati	1983	○ 202	○ 134						
Binondo	1985	○ 714	● 432	● 707	● 787				
*Balete	1989	○	○	○	○				
*Escolta	1991	–	–	–					
Vitas	1997	○ 469	○ 472	○ 456	○ 404	○ 387	○	○	○
*Balut	1997	○ 693	○ 838						
San Andres	1998	○ 196	○ 194	○ 196	○ 198				

Legend
* PS with Submersible Pump for Main Equipment
○ Operational
● Proposed for Overhauling in 2004
738: Values of lower colums indicate OP hours in (2003)

2) Insufficient Budget Causes Various Problems

The O & M activities of major pumping stations are beset by the shortage of spare parts and manpowers due to the lack of budget, though periodic maintenance works were duly conducted until 1999. According to the annual expenditure in 2003, the personnel cost accounted for approximately 50% of the annual expenditure, followed by fuel cost for 20% and material, supply of spare parts for the pumping stations and garbage handling equipment for 5%. The budget constraints are affecting the O & M activities in the following manner:

- Insufficient procurement of spare parts required for scheduled overhauling,
- Insufficient routine O & M activities rendered, especially overtime work during heavy rains and flood emergencies, and
- Difficulties in keeping the necessary number of qualified engineers and skilled laborers required for the O & M of pumping stations due to the low wage level.

3) Solid Waste Problems at Pumping Stations

Every major drainage pumping station is faced with the problem of removing daily a large volume of solid waste flowed in which is affecting the pump operation and damaging the pump equipment; also, the removed solid waste is causing problems like bad odors, flies, and eventually outbreak of diseases.

(3) O & M for Drainage Channel

DWO manages the activities of dredging, desilting, declogging, repairing and rehabilitation of drainage channels, and construction of additional drainage facilities by remittance and directly undertaking works. The management area covers 17 LGUs area.

1) Innovation of Inspection System for Reduction of Illegal Activities

The drainage channels require reducing various illegal activities through the routine O & M activities. In order to protect the drainage channels, the O & M organization should take the necessary actions as follows:

- Innovation of an inspection system to reduce informal settlements and illegal activities along drainage channels
- Relocation of informal settlers in and along the drainage channels to conduct routine O & M activities

2) Improvement of Budget Allocation for Drainage Channels

Due to the insufficient budget allocation for the O & M activities of drainage channels, the Drainage and Waterways Operation (DWO) is unable to conduct proper O & M activities and arrange necessary equipment and manpower for declogging drainage mains and dredging open waterways to recover and sustain the drainage capacity.

3) Improvement of Relation among O & M Organizations

For proper management of drainage facilities: pumping stations and drainage channels, integrated management of the existing O & M organizations and equipment is required. PSFO and DWO should be managed by one operation.

MMDA and LGUs require improving the relations for the O & M activities and the management of their O & M equipment. For proper management of the equipment it is important to establish a centralized warehouse with supply of fast moving parts to keep the DWO and PSFO equipment in operation.

Also it is important for the O & M activities of the drainage system to involve the solid waste collection activities in and along the drainage channels.

2.6 SOLID WASTE MANAGEMENT

The cities of Manila, Pasay and Makati are conducting solid waste collection daily. The questionnaire survey results revealed that solid waste collection services are available except for a small percentage of households at the barangay level; but still illegal dumping of solid waste into the drainage channels is observed in the core area.

For drainage improvement it is very important to reduce the illegal dumping of solid waste into drainage channels and it is necessary for the barangays along drainage channels to reduce illegal dumping of solid waste into drainage channels through the improvement of the solid waste collection methods.

There are some barangays located along esteros/creeks with very narrow roads, not allowing even mini trucks to pass, or with no roads at all, therefore, it is necessary for the barangays to participate in solid waste collection.

In order to improve the solid waste collection, public participation at barangay level is basic. For innovation of public participation enhancement of the Information, Education and Communication (IEC) campaign by MMDA and LGUs is important.

2.7 PROBLEMS AND COUNTERMEASURES

The drainage problems necessary to be solved are summarized as follows:

Table S.2.8 Problems and Countermeasures

Problems to be solved	Countermeasures
Major drainage pumping stations mostly become old and need urgent rehabilitation.	- Early rehabilitation of drainage pumping equipment - Preparation of a rehabilitation program for each pumping station - Increment of the budget for O & M
Due to the rapid urban development, some of the drainage facilities (drainage channels and drainage pumping stations) are finding it difficult to meet the increased stormwater runoff.	- Remedial works and additional works for drainage improvement
Most of the drainage channels have decreased design drainage capacities due to the heavy channel bottom deposits.	- Execution of dredging and declogging - Public participation to O & M activities - Improvement of solid waste collection system at barangay level - Promotion of public involvement in solid waste collection system - Reduction of informal dumping by innovating inspection system and enhancing public awareness.
Increase of informal settlers in drainage channels to cause decreasing the drainage capacity and become obstacles for O & M activities.	- Inspection against informal activities - Relocation of informal settlers in drainage channels
Insufficient O & M activities.	- Increment of O & M budget of MMDA - Formulation of O & M plan - Provision of O & M equipment - Improvement and strengthening of O & M organizations - Innovation of public participation for O & M activities

3. HYDRAULIC SIMULATION

3.1 SIMULATION ON INUNDATION

A hydrological and hydraulic model has been developed for the core area and simulation for inundation is conducted by MOUSE as follows:

- Simulation on existing conditions: 1999 floods, drainage facilities without project conditions (Design rainfalls: 2-year, 3-year, 5-year, 10-year, 20-year and 30-year rainfall events)
- Simulation on planning scenarios (with project conditions, including alternatives) for assessment of effects as follows:
  - Existing conditions (depth and duration)
  - After dredging and declogging (depth and duration)
  - After completion of the Master Plan (depth and duration)
  - No operation of drainage pumps and gates (depth and duration)

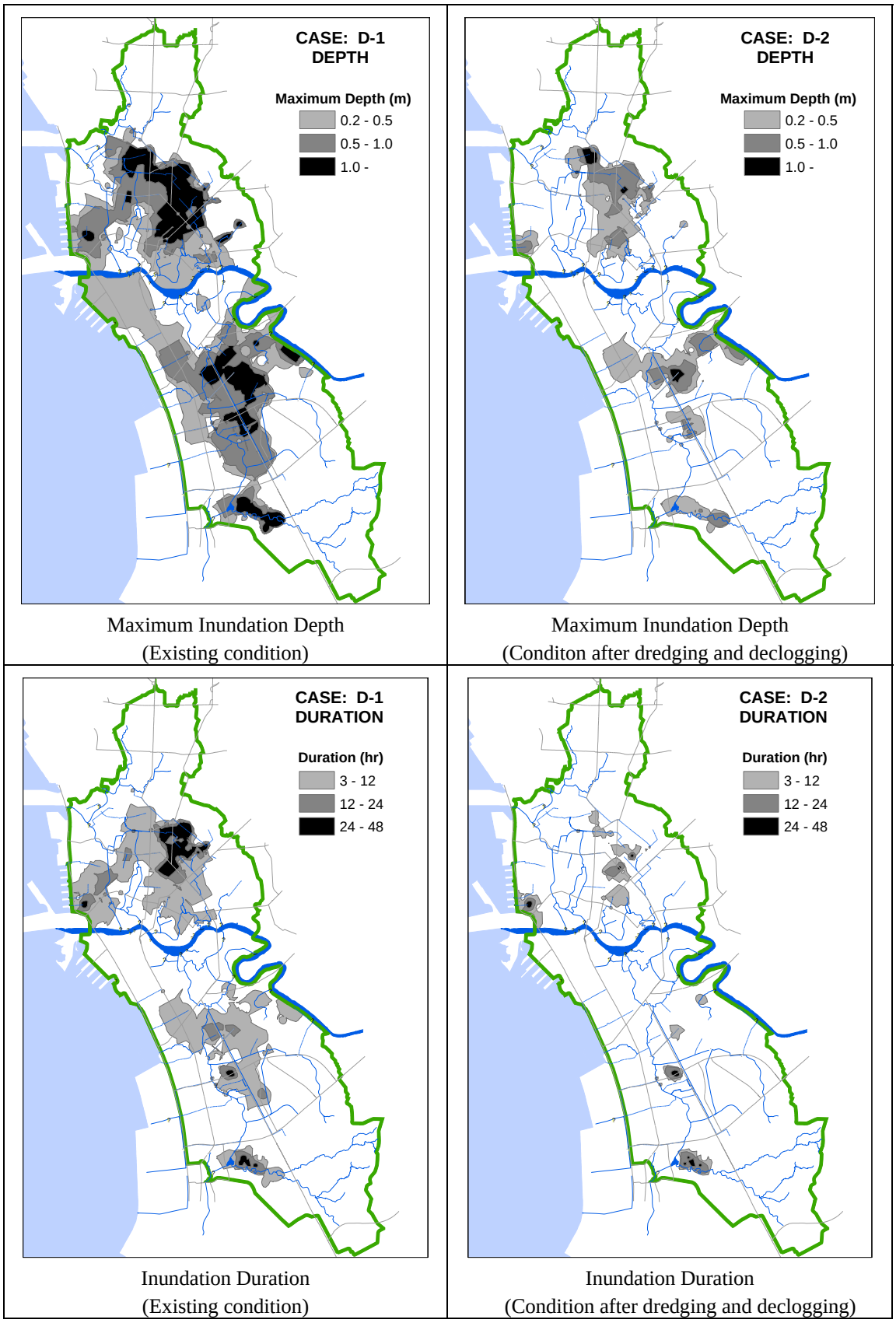
The results of simulation are shown in *Figues S.3.1~S.3.3*.

3.2 INUNDATION CHARACTERISTICS OF THE STUDY AREA

The characteristics of the study area resulting from the hydraulic simulation are summarized as follows:

- Floodwater of the deep inundated area over 0.5 – 1.0 m in depth increases significantly from 2-year flood to 5-year flood, and gradually expands for over 5-year flood.
- Floodwater of the long inundated area over 12 – 24 hours in duration seems not to increase for below 5-year flood, but gradually increases for over 5-year flood.
- The areas with 0.5 – 1.0 m in depth and 12 – 24 hours in duration seem to be reduced to about 1/3 of those in the existing condition by recovering the original discharge capacities of the existing channels.

The results of simulation on inundation characteristics are shown in *Figures S.3.4*.



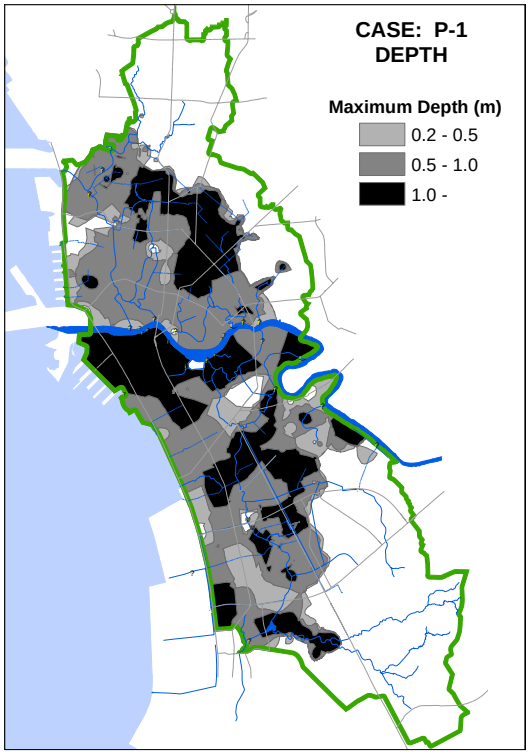
Maximum Inundation Depth
(Existing condition)

Maximum Inundation Depth
(Conditon after dredging and declogging)

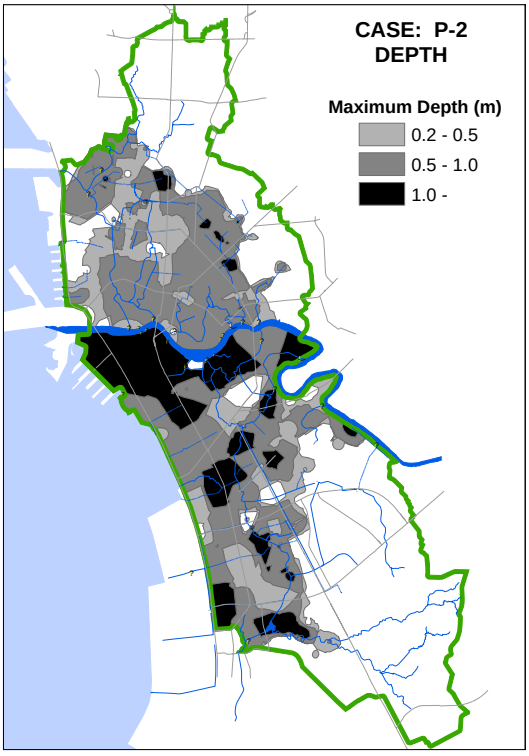
Inundation Duration
(Existing condition)

Inundation Duration
(Condition after dredging and declogging)

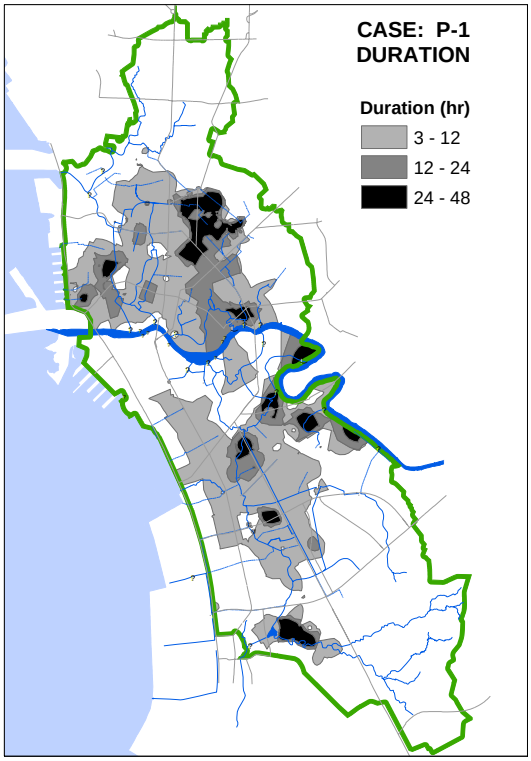
Figure S.3.1 Simulated Inundation Conditions - Effect of Dredging and Declogging



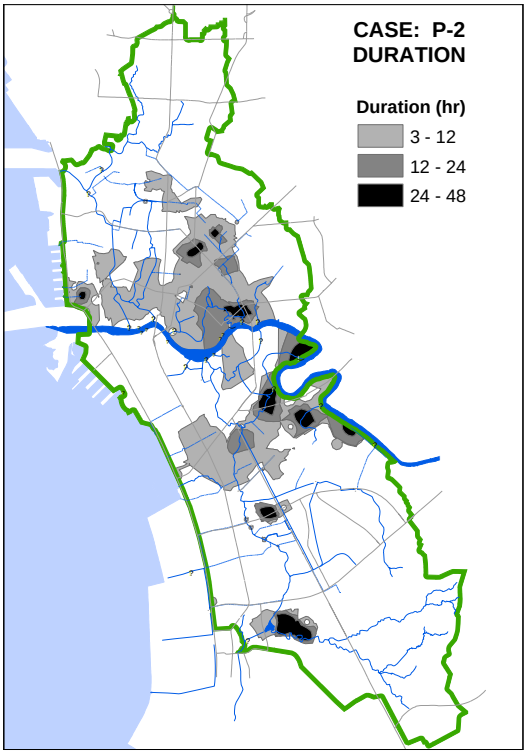
Maximum Inundation Depth
(Without pump and gate operation for existing condition)



Maximum Inundation Depth (Without pump and gate operation for condition after dredging and declogging)

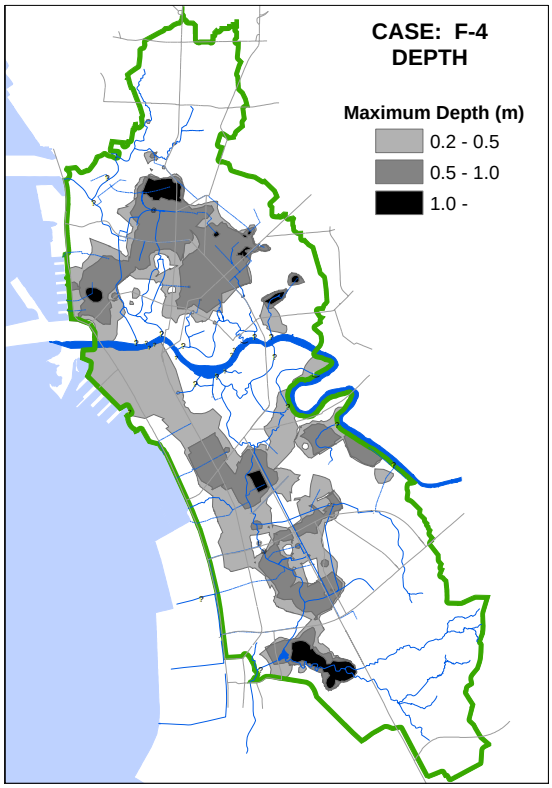


Inundation Duration
(Without pump and gate operation for existing condition)

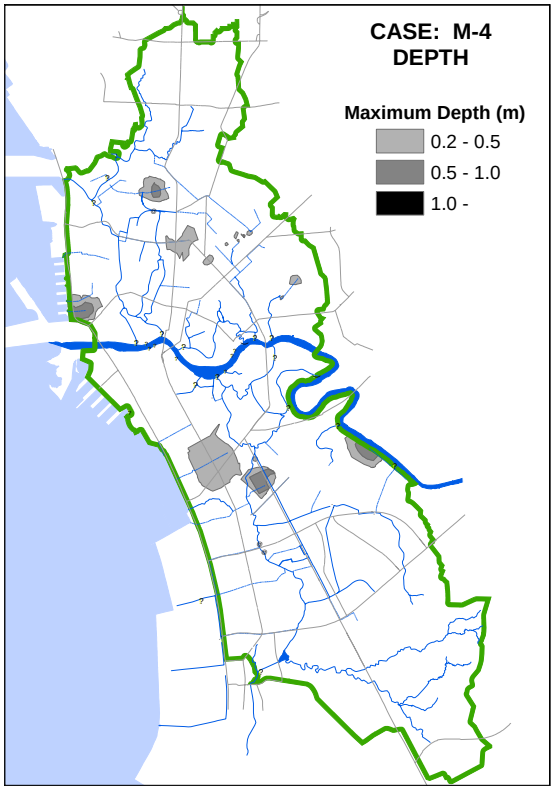


Inundation Duration (Without pump and gate operation for condition after dredging and declogging)

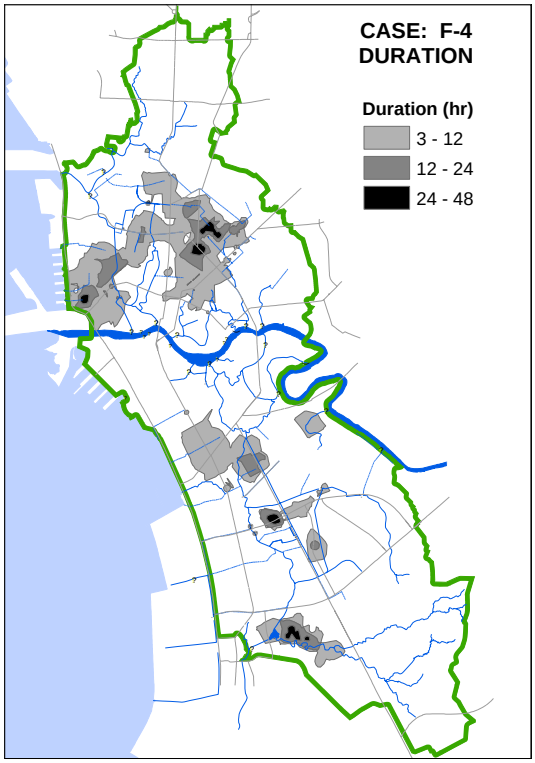
Figure S.3.2 Simulated Inundation Conditions - Effect of Pumping Stations



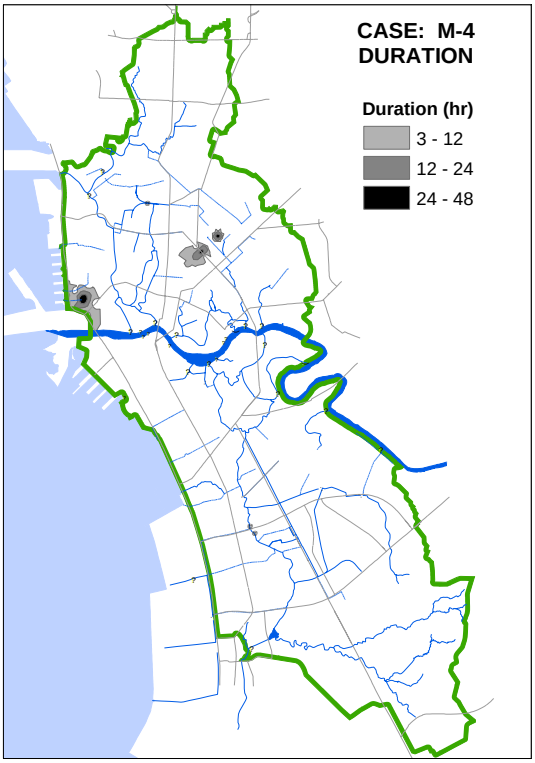
Maximum Inundation Depth
(Condtion after Phase 1)



Maximum Inundation Depth
(Condition after completion of proposed works)

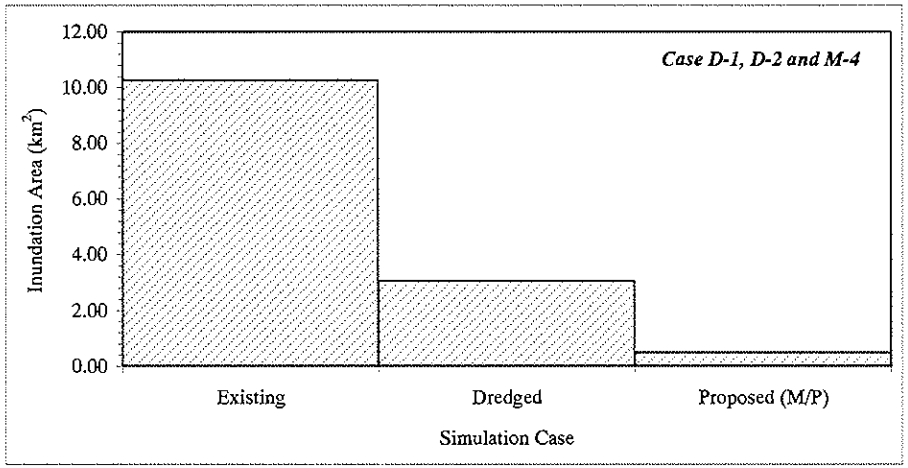


Inundation Duration
(Condtion after Phase 1)

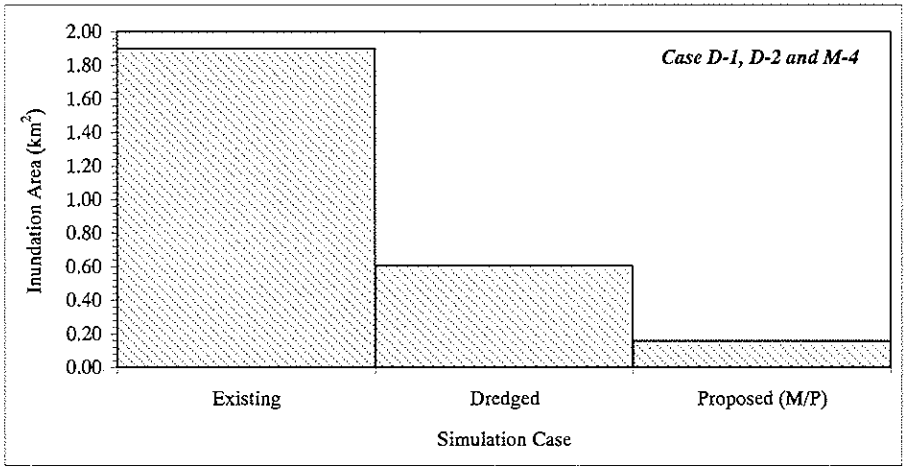


Inundation Duration
(Condition after completion of proposed works)

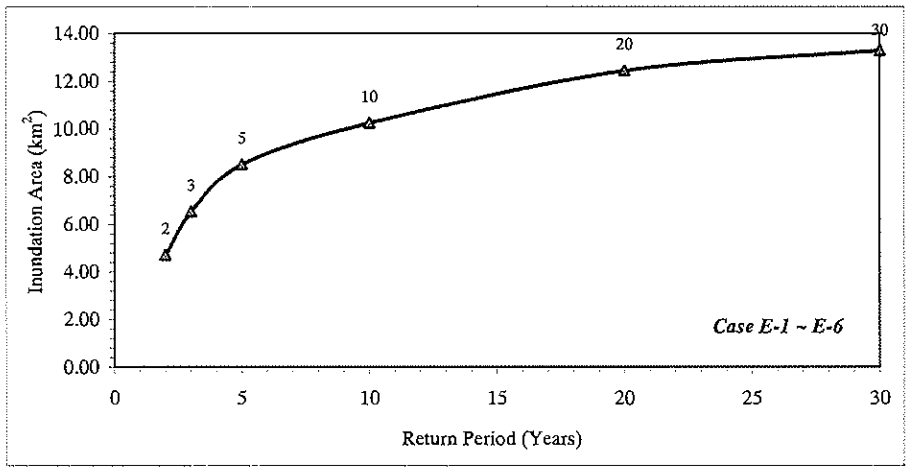
Figure S.3.3 Simulated Inundation Conditions after Completion of Proposed Works



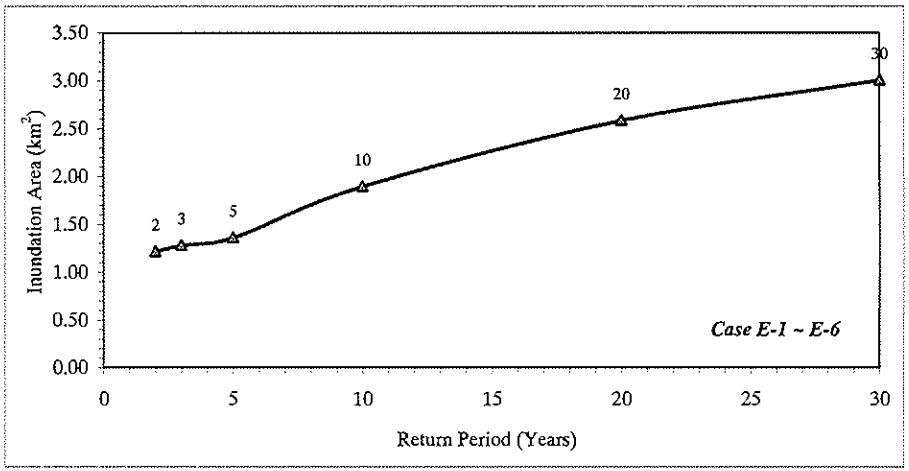
Inundation Area (10-Yr Return Period) by Improvement Condition for Depth 0.5 ~ 1.0 m



Inundation Area (10-Yr Return Period) by Improvement Condition for Duration 12 ~ 24 hrs



Inundation Area by Return Periods for Depth 0.5 ~ 1.0 m under Existing Condition



Inundation Area by Return Periods for Duration 12 ~ 24 hrs under Existing Condition

Source: Hydrodynamic simulation results by MOUSE

Figure S.3.4 Inundation Characteristics of the Study Area from Simulation Result

4. MASTER PLAN

4.1 BASIC CONCEPT FOR MASTER PLAN

(1) Basic Concept

The basic concept of formulation of a master plan for drainage improvement of the core area of Metropolitan Manila is discussed as follows.

1) Measures for reduction of flood and inundation conditions (extension, depth and duration) and severe regional inundation areas in both North Manila and South Manila are to be considered. The measures are composed of rehabilitation of the existing drainage facilities, remedial works and/or additional works to cope with the current runoff conditions during heavy rains, including strengthening of the existing O & M organizations and activities, and promotion of public participation at barangay level.

   Due to the assessment of the flood and inundation damage in the 1999 flood, the flood and inundation affected a half of the core area and caused a severe inundation locally in both North Manila and South Manila. The flood and inundation affected 1.24 million people, 97,000 houses and about a half of the road network, causing heavy traffic and disturbing commercial activities and urban living in the core area. The drainage improvement in the core area will bring various effects of not only reducing flood and inundation damages to the people living in flood and inundation area, but also promoting economic activities in Metropolitan Manila, which could level up the living conditions in general in Metro Manila.

2) Rehabilitation of the existing drainage facilities should be the base for drainage improvement of the core area. The existing drainage facilities are composed of drainage pumping stations and drainage channels: esteros/creeks, drainage main/outfalls and laterals; however, major drainage pumping stations are aging and major drainage channels like esteros/creeks are missing the discharge capacities because of heavy deposits caused by illegal dumping of solid waste.

3) The 15 major drainage pumping stations are key facilities for the drainage system in the core area and should be sustained by proper rehabilitation, because they have been working effectively in improving the stormwater drainage in the core area. However, 10 of them have been in operation since the 1970s-1980s and have had problems of deterioration of casing liner, corrosion of guide casing, crack of various major parts and units of engine, etc., Two others are also requiring replacement of pump equipment.

4) The capacities of the existing drainage channels should be recovered by dredging and declogging, because the discharge capacities of existing drainage channels are assessed mostly as less than the peak discharge with 2-year return period rainfall event, though they were designed to have the capacities to convey the peak discharge with 10-year return period, and required to recover the original capacities by dredging *(refer to Figures S.4.1 and S.4.2).* The volume of bottom deposits of drainage channels are estimated to be 840,000 m^3 in esteros/creeks and 80,000 m^3 in drainage mains/outfalls, which should be dredged and declogged in order to recover the original capacities of the existing drainage channels.

5) The informal house buildings in drainage channels should be moved or relocated before dredging bottom deposits of drainage channels. There are numerous informal house buildings encroaching public spaces in and along drainage channels, which are part of the

causes of missing discharge capacities of the drainage channels and become major obstacles for the O & M activities including dredging. For improvement of the existing drainage channels it is indispensable to remove informal house buildings within drainage channels before dredging. Among 2,100 house buildings within esteros/creeks, which have been identified in the Study, 1,900 house buildings should be removed before dredging works and the informal settlers who live in those house buildings should be relocated during the Master Plan stage by stage. Social framework for resettlement is considered.

6) Proper O & M organizations and activities should be required to sustain the discharge capacities and protect the drainage channels against illegal activities: encroachment of informal settlers and dumping of garbage/waste in drainage channels. For this purpose strengthening of O & M organizations and community-involved O & M system are considered.

7) For improvement of the drainage facilities in the core area many agencies of central and local governments are to be involved and it is considered to establish an optimum coordination organization for smooth implementation of the projects.

8) Public participation should be promoted at the barangay level by enhancement of public awareness for drainage management in order to improve and sustain the drainage channels including garbage/solid waste collection management, and various community-involved activities are considered.

(2) Target Year

Target year of the Master Plan is set at the year of 2020, and divided into three terms as follows:

- 1st P hase projects from 2005 to 2010
- 2nd Phase projects from 2011 to 2015
- 3rd Phase projects from 2016 to 2020

(3) Component of the Master Plan

The Master Plan for drainage improvement in the core area is composed of the following:

- Improvement and rehabilitation plan for drainage channels,
- Improvement and rehabilitation plan for drainage pumping stations,
- Improvement plan for solid waste management along drainage channels,
- Improvement plan for O & M organizations and activities, and
- Preparation of social framework of resettlement.

The detail of each component is discussed below.

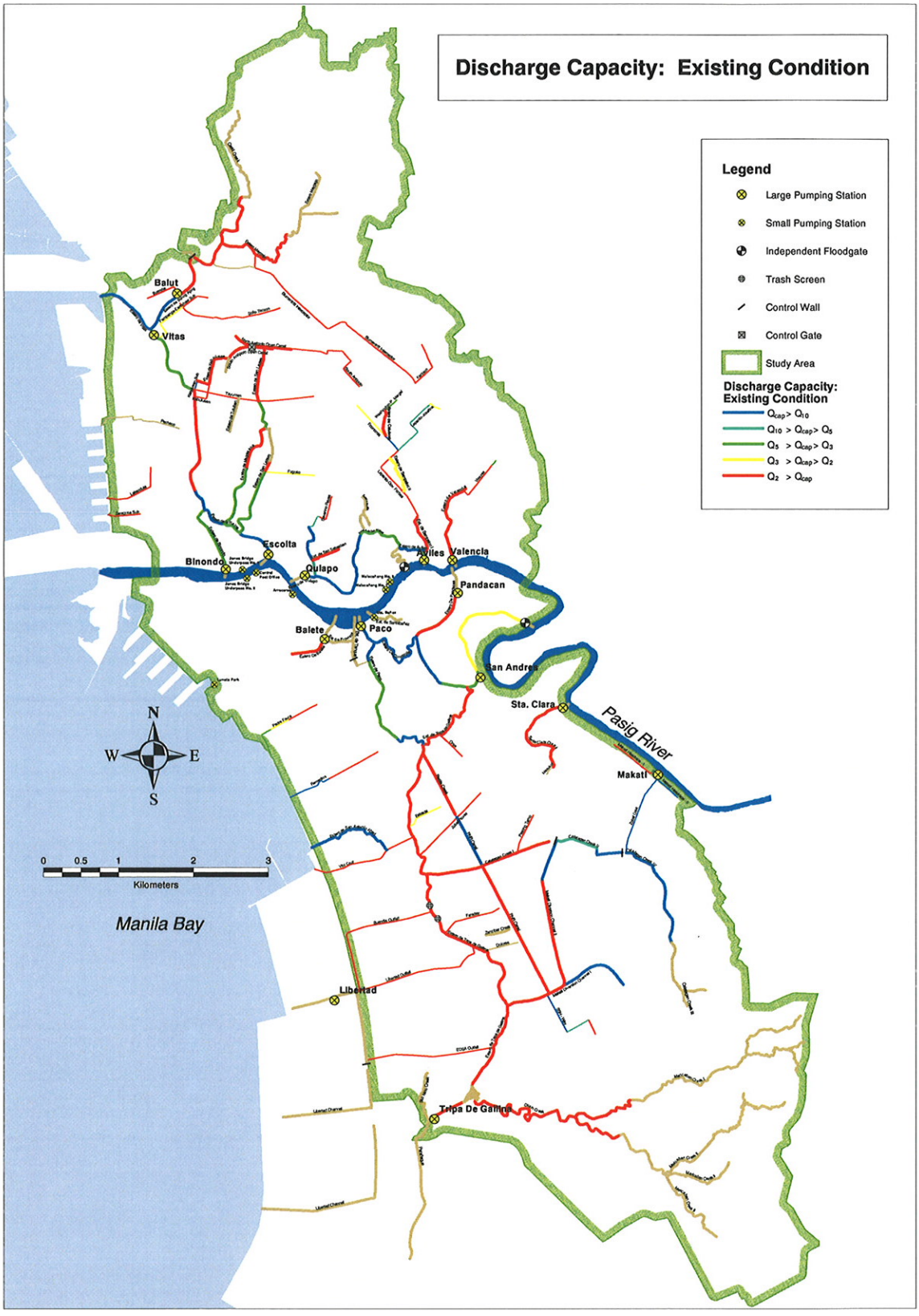


Figure S.4.1 Discharge Capacity of Drainage Channels in Existing Condition

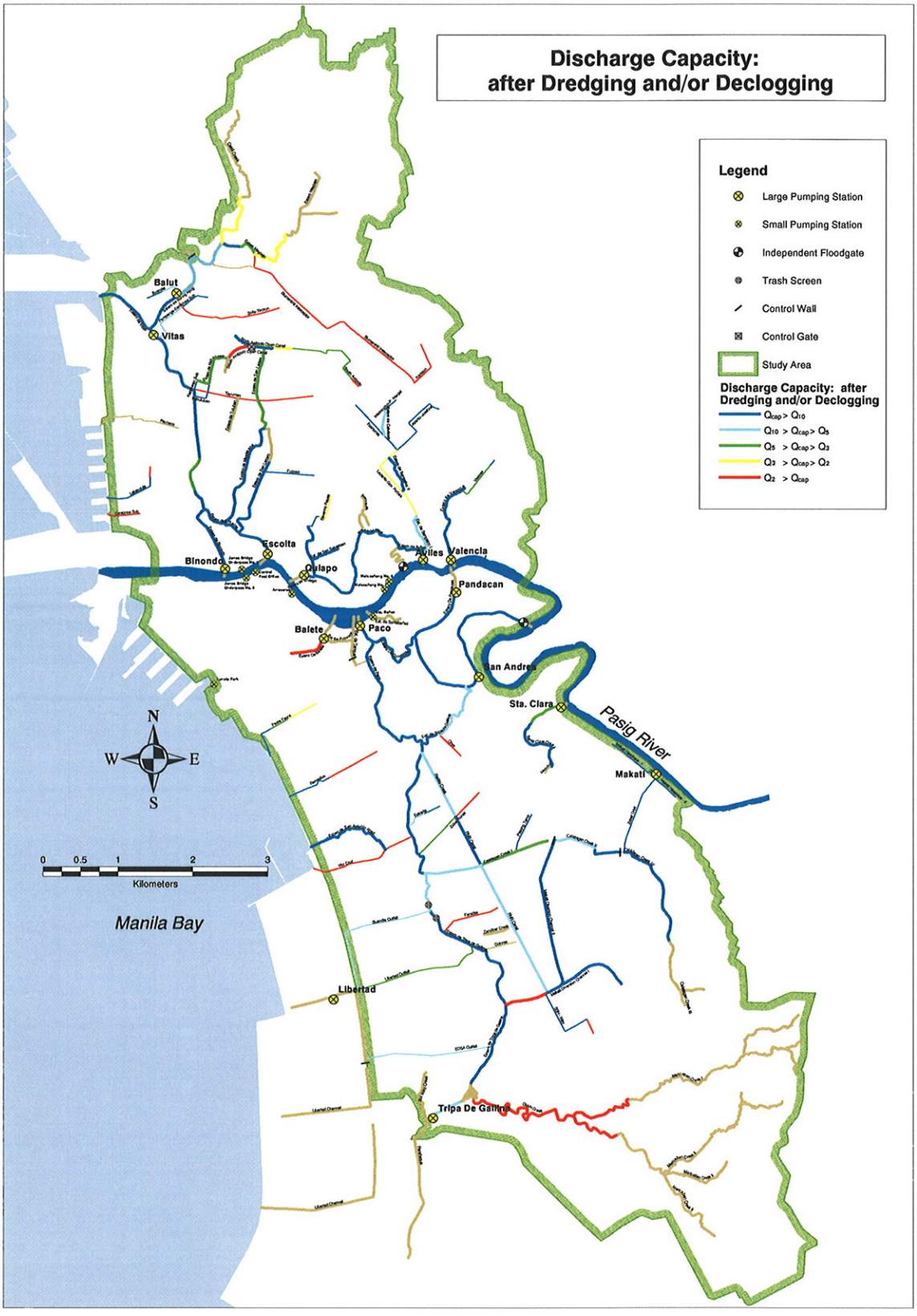


Figure S.4.2 Discharge Capacity of Drainage Channels after Dredging and Declogging

4.2 DRAINAGE CHANNEL IMPROVEMENT AND REHABILITATION PLAN

(1) Measures for Drainage Improvement

In order to achieve drainage improvement in the core area of Metropolitan Manila, the structural, non-structural and supporting measures are required.

(2) Design Scale

According to the "Plan for the Drainage of Manila and Suburbs", prepared in 1952, the major channels were designed for a 10-year return period, whereas local channels had no prepared action. A subsequent study, the 1984 Metro Manila Integrated Urban Drainage and Flood Control Plan, proposed a 10-year return period for design discharge for major channels and drainage pumping stations, and a 2-year return period for local channels.

The present channels and facilities have principally been constructed and improved based on the above-mentioned plans. The proposed scale of design for additional works is shown in the following table.

Table S.4.1 Design Scale for Additional Works

Drainage Pumping Station (15 Large Pumping Staions)	*10 – year return period (269 mm/24hours)*
Trunk Channel	*10-year return period (80 mm/hour)*
Secondary Channel Interceptor to be proposed	*3-year return period (60 mm/hour)*
Tertiary Channel,Lateral Small Pumping Station	*To recover original capacity, not specified*

Note: - The Mean Spring High Tide Level (El. 11.34 m) is applied for design high water level on Manila Bay.
- As for the design high water levels along the Pasig River, the design high water level by the on-going Pasig-Marikina improvement project is applied, which is equivalent to a 30-year return period event. For the Parañaque River, the water levels for a 30-year return period event are applied.
- The DPWH datum of 10.475 m is equivalent to Mean Sea Level (MSL)

(3) Rehabilitation Works for Drainage Channels

The present drainage channels have mostly lost their original cross-sectional areas owing to bottom deposits of solid waste/silt in drainage channels. In order to recover original cross-sectional areas, dredging and declogging are required. The total volume to be dredged and declogged is estimated to be about 920,000 m³, as shown in the following table.

Table S.4.2 Summary of Dredging and Declogging Volumes

Unit of volume: 1,000 m^3

Location	*Works*	*Trunk channel*		*Secondary channels*		*Tertiary channel*		*Total volume*
		No.of channel	*Volume*	*No. of channel*	*Volume*	*No. of channel*	*Volume*	
North Manila	*Dredging*	*9*	*314*	*5*	*71*	*7*	*31*	*416*
	Declogging	-	-	*9*	*28*	*13*	*21*	*49*
	Sub total	*9*	*314*	*14*	*99*	*20*	*52*	*465*
South Manila	*Dredging*	*6*	*316*	*4*	*98*	*2*	*10*	*424*
	Declogging	-	-	*11*	*30*	*4*	*2*	*32*
	Sub total	*6*	*316*	*15*	*128*	*6*	*12*	*456*
Total	-	*18*	*630*	*29*	*227*	*26*	*64*	*921*

For recovering the original capacities of the existing drainage channels rehabilitation and improvement works proposed are as follows.

- **Rehabilitation by dredging and declogging of drainage channels**
- **Improvement by related (or remedial) works**
  - Improvement of existing box culverts
  - Improvement of existing maintenance holes (or manholes)
  - Installation of stop log gates to drainage mains/outfalls required for maintenance works

Before the implementation of dredging, it will be necessary for the informal house buildings (or structures) in drainage channels to be removed or relocated. The informal house buildings identified and households estimated are 1,900 and 5,500, respectively.

(4) Additional Works

The additional works for drainage channels are proposed as follows:

North Manila

1) Vitas-Binondo-Escolta drainage block
   - Additional works of South Antipolo area
2) Quiapo-Aviles drainage block
   - Additional works of channels to Quiapo Pumping Station
   - Additional works for Aviles drainage area
3) Maypajo-Blumentritt-Balut drainage block
   - Additional works of Estero de Vitas
   - Additional works of Blumentritt Interceptor

South Manila

1) Libertad-Tripa de Gallina drainage block
   - Additional works for severe inundation area in South Manila
   - Additional works of Libertad pond
   - Additional works of Dilain/Maricaban Creek area
2) Balete drainage block
   - Additional works in Estero de Balete

4.3 IMPROVEMENT AND REHABILITATION PLAN FOR DRAINAGE PUMPING STATIONS

The 15 major drainage pumping stations are keys of the drainage system in the core area and optimum O & M activities are indispensable. According to the investigation, the drainage pump facilities have mostly become old and require rehabilitation. Especially 12 drainage pumping stations among them which were constructed in the 1970s-1980s require urgent countermeasures.

The existing and proposed drainage capacities of the drainage pumping stations are shown in the following table.

Table S.4.3 Discharge Capacity of Pumping Stations

Pumping station	*Existing discharge capacity*	*Proposed discharge capacity*	*Remarks*
Aviles	*15.6 m^3/s*	*18.6 m^3/s*	*+ 3 m^3/s*
(Pump Gates at existing Uli-Uli Independent Floodgate)	-	*2.0 m^3/s*	*New*
Quiapo	*10.8 m^3/s*	*10.8 m^3/s*	*No change*
Valencia	*11.8 m^3/s*	*11.8 m^3/s*	*No change*
Binondo	*11.6 m^3/s*	*11.6 m^3/s*	*No change*
Escolta	*1.5 m^3/s*	*1.5 m^3/s*	*No change*
Vitas	*32.0 m^3/s*	*32.0 m^3/s*	*No change*
Balut	*2.0 m^3/s*	*2.0 m^3/s*	*No change*
Pandacan	*4.4 m^3/s*	*4.4 m^3/s*	*No change*
Tripa de Gallina	*57.0 m^3/s*	*57.0 m^3/s*	*No change*
Sta. Clara	*5.3 m^3/s*	*5.3 m^3/s*	*No change*
(Pump Gates in existing Sta. Clara Drainage Basin)	-	*2.0 m^3/s*	*New*
Paco	*7.6 m^3/s*	*7.6 m^3/s*	*No change*
Libertad	*42.0 m^3/s*	*42.0 m^3/s*	*No change*
Makati	*7.0 m^3/s*	*7.0 m^3/s*	*No change*
Balete	*3.0 m^3/s*	*3.0 m^3/s*	*No change*
San Andres	*19.0 m^3/s*	*19.0 m^3/s*	*No change*
(Pump Gates at outlet of Perlita Creek)	-	*2.0 m^3/s*	*New*

The detailed overall technical checking of drainage pump equipment and appurtenant facilities are conducted from the mechanical and electrical viewpoints, based on the survey results by the Flood Control Management Services of MMDA from May to June 2004. The technical checking and diagnosis are prepared in accordance with the criteria which are applied in the irrigation pumping stations by Japan's Ministry of Agriculture, Fisheries and Forest. The criteria are shown in *Annex-2*. The technical checking consists of the following two steps:

- 1st step is for overall checking of mechanical and electrical parts, and
- 2nd step is for repair and replacement of mechanical parts that received a score above 10 points during the 1st step checking.

In the Study, the 1st step checking was made mainly by visual observation, trial pump operation and diagnosis without disassembly of the pump equipment. The results of the technical checking are shown in the following table.

Table S.4.4 Technical Checking Results for Mechanical and Electrical Parts

Pumping Station	Completion Year	Operation Hour	Mechanical Parts								Total Scoring of Electrical Parts
			Main Pump	Engine	Gearbox	Discharge Valve	Flap Valve	Screen, Hori. and Inclined Conveyors	Auxi. Pump	Total Scoring	
Aviles	1976	14,650	80	72	48	55	70	196	118	639	40
Quiapo	1976	15,830	220	176	124	164	84	444	256	1,468	39
Valencia	1976	10,790	72	58	36	34	10	618	87	471	34
Pandacan	1976	10,890	30	23	16	10	18	116	30	243	43
Paco	1977	16,630	15	12	23	6	5	78	151	290	41
Sta. Clara	1977	7,420	29	55	22	8	6	54	34	208	41
Tripa de Gallina	1977	8,010	125	171	100	143	38	467	0	1,044	43
Libertad	1977	12,880	58	50	32	38	0	118	80	376	39
Makati	1984	4,030	11	12	6	6	10	52	41	138	38
Binondo	1985	8,220	33	38	11	25	40	95	49	291	43
Balete	1988	140	59	0	-	-	-	-	-	59	37
Escolta	1982	360	24	35	-	-	-	-	-	59	42
Vitas	1997	4,080	5	12	0	0	0	24	12	51	14
Balut	1997	3,700	4	11	-	0	0	30	11	56	15
San Andres	1997	1,150	0	2	0	2	0	20	14	38	14

Note: Criteria for Mechanical and Electrical Checking and Diagnosis are shown in Annex-1

For mechanical parts

1) The pump equipment and appurtenant facilities of three pumping stations: Vitas, Balut and San Andres, which were constructed in the 1990s, are still in good condition and able to function for the coming 20 years with periodical inspection and maintenance works including overhauling.

2) However, the other 12 pumping stations are required rehabilitation and further checking through overhauling for programming of repair and replacement, and especially the four pumping stations of Aviles, Quiapo, Valencia and Tripa de Gallina, require urgent rehabilitation works.

3) The present pump equipment at Escolta (total capacity: 1.5 m^3/s) and Balete (total capacity: 3.0 m^3/s) are submergible type with discharge pipes installed over or nearby the existing gate and their operation efficiencies are assumed quite low, and proposed to be converted into ordinary fixed type pumps or gate pumps. The present additional submergible pump installed over drainage gates is recommended to convert into ordinary fixed type in connection with rehabilitation works.

For electrical parts

1) The electrical parts of Vitas, Balut and San Andres stations are presently in good condition because they are still relatively new. It is proposed that performance characteristics of electrical apparatus be kept through the ordinary maintenance activities in future.

2) For the other 12 pumping stations, scorings largely exceeded 20 points, which is a critical mark for repair or replacement. Evaluated scores clarify that it is required for all parts to be urgently replaced. It also can be said that temporary repair or partial replacement of a

chain of electrical apparatus to improve its performance characteristics is costly and not recommendable. Therefore, it is concluded that electrical apparatus at the 12 pumping stations should be replaced urgently.

It is proposed to conduct overhauling at all pumping stations prior to rehabilitation works and, based on the overhauling results, detailed rehabilitation programs should be formulated in the next implementation stage.

Annex-2 Criteria for Mechanical and Electrical Checking and Diagnosis

1) Criteria for Mechanical Checking and Diagnosis

Pump Equipment	*Scoring for Aged Ratio*				*Scoring for Fault Ratio*		
	2.5	*2.0*	*1.5*	*1.0*	*2.0*	*1.5*	*1.0*
Main Pump	*Passed years; More than 35*	*Passed years; 35 to 25*	*Passed years; 20 to 10*	*Passed years; Less than 10*	*Fault times; More than 3*	*Fault times; 2 to 1*	*Fault times; No fault*
Diesel Engine	*More than 27*	*27 to 15*	*15 to 5*	*Less than 5*	*More than 3*	*2 to 1*	*No fault*
Gear Box/ Butterfly Valve	*More than 30*	*30 to 20*	*20 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*
Non-Return Valve/ Auto screen/ Conveyor/ Flap Valve	*More than 25*	*25 to 20*	*20 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*
Auxiliary Pump	-	*More than 15*	*15 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*

Source: Ministry of Agriculture, Fisheries and Forest, Japan

2) Criteria for Electrical Checking and Diagnosis

Item	*Condition*		*Scoring*
Aged	*15 to 10 years*		*6*
	20 to 15 years		*12*
	More than 20 years		*20*
Ordinary Condition	*Daily average ambient temperature above 40ºC*		*6*
	Anuual average humidity above 85%		*6*
	Outdoor type		*6*
Maintenance Record	*Trace of short circuit*		*9*
	Water penetration or condensation		*3*
	Repair work on conductive part in the past		*6*
	Replacement of main equipment (less than 10%)		*6*
	Replacement of main equipment (more than 10%)		*9*
Deterioration	*Enclosure*	*Peeling of paint, rust, damage*	*3*
		Water penetration or condensation	*3*
		Damage of packing	*3*
		Losing of door, damage of handle	*3*
	Conductive part	*Change in color due to overheating on busbar or termination*	*6*
		Crack, damage or deformation of busbar support	*3*
		Change in color due to overheating on terminal block	*3*
		Crack, damage or deformation of terminal block	*3*

Source: Ministry of Agriculture, Fisheries and Forest, Japan

4.4 IMPROVEMENT PLAN FOR SOLID WASTE MANAGEMENT

The LGUs in the core area of Metropolitan Manila are conducting daily solid waste collection. However, along esteros there are some areas difficult for the collection vehicles to pass because of the narrow roads or no access roads.

In order to improve the solid waste collection at barangays the public-involved collection system is required. But for the public participation at the barangay level it would be difficult to improve and sustain the capacities of drainage facilities properly. Therefore, in order to promote the public participation at barangays, barangay environmental management activities to include the appointment of Barangay Environmental Manager (BEM) and the formation of Team ESTERO (Environmental Strategic Task for Estero Renewal Organization) are proposed.

The experiment on BEM and Team ESTERO activities is conducted at three pilot barangays for improvement of the solid waste collection system as a part of the activities.

(1) Improvement of Solid Waste Collection through Barangay Environmental Management

There are 1,191 barangays in the core area, and barangay institutional strengthening should be extended to the whole study area from viewpoint of urban drainage and environmental improvement. Therefore, it is proposed to introduce the BEM and Team ESTERO activities into 376 barangays, which are located along esteros. The phasing of activities is shown in *Table S.4.5.*

Table S.4.5 Priority Barangays for Introduction of BEM and Team ESTERO

Target Year	No. of Barangays for Introduction of the System
Short-term 2005 – 2010	137
Mid-term 2011 to 2015	140
Long-term 2016 - 2020	99

(2) Promotion of Information, Education and Communication (IEC) through BEM and Team ESTERO

The government pays efforts to the activities of Information, Education and Communication (IEC) campaign to enhance public awareness to improve the solid waste collection at barangays. The Study proposes to promote IEC campaign at the barangay level in order to enhance public awareness for improvement of barangay environment: management of solid waste collection, cleaning drainage channels, and prevention of illegal dumping of solid waste into drainage channels for sustaining drainage capacities.

4.5 IMPROVEMENT PLAN FOR O & M

Part of the responsibility of the flood control section of DPWH was transferred to MMDA in August 2002. Now MMDA is responsible for O & M of drainage system in the core area and LGUs are responsible for laterals along the local roads. It is necessary for O & M activities of drainage channels to involve barangay communities under LGUs and to improve the coordination between MMDA and LGUs.

(1) Improvement of O & M Organization and Activities

In order to support and sustain the existing drainage facilities an overall O & M system should be set up. The principles for setting up an overall O/M system are proposed as follows:

- To organize a coordination committee consisting of MMDA, LGUs and DPWH
- To establish an overall O & M system for drainage facilities: channels, pumping stations, solid waste management, control of illegal social activities, and execution of Information, Education and Communication campaign (IEC)
- To clarify the responsibilities for each O & M organization

  MMDA
  - Esteros/creek
  - Drainage pumping stations
  - Solid waste collection management along drainage channels
  - Control of illegal activities
  - Information, Education and Communication (IEC) campaign

  LGUs
  - Laterals along local road
  - Solid waste collection management along drainage channels
  - Information, Education and Communication (IEC) campaign
  - Barangay participation for O & M activities
  - Resettlement of informal settlers

Under the direction of the committee, one drainage basin (or combined basins) integrating drainage channels and drainage pumping stations is to be operated and maintained in principal by one divisional office of MMDA. In this regard, reorganization of the present division offices is proposed.

For smooth and effective O & M, a guideline for comprehensive drainage improvement, and detailed community-involved O & M measures including solid waste collection, illegal activity control, IEC campaign, etc., are discussed.

The required institutional aspects and the improved funding system are also to be discussed and established through the coordination committee.

(2) Budget

The revenue of MMDA is mainly composed of IRA and other subsidy from Central Government, internal revenue, and 5% contribution from LGUs shown in the following table.

Table S.4.6 MMDA Revenues

	2002 (Actual)	2003 (Estimate)	2004 (Projection)
Revenue (Php Million)	2,295	2,693	2,739
Share	100%	100%	100%
IRA* from Central Government	13%	12%	12%
Other Subsidy from Central Gov.	30%	32%	32%
Internal Revenue	9%	12%	24%
5% Contribution from LGUs *	29%	32%	32%
Inappropriate Surplus	19%	11%	0%

Sources: Data as of March 2004 provided by Budget and Financial Section, MMDA

For the budget of O & M under the flood control management service, the Regular Flood Control Maintenance Fund and Quick Response Fund (QRF) as Calamity Fund are available.

This QRF is an urgent financial burden from DPWH. Urgent solid waste collection at the pumping stations after the serious flood was sometime covered by QRF.

Number of O & M experts decreasing due to low wage level and insufficient budget allocation are primary key issues for O & M activities of PSFO and DWO.

The total annual expenditure of Flood Control Management Service of MMDA in 2003 was Php314,845,000 including the capital outlays and the O & M expenditure for personnel and maintenance was Php217,845,000.

The survey on manpower requirement revealed that the increasing rate of the manpower requirement is 10 %. In this study, the O & M cost for Flood Control Management Service will be roughly estimated by applying this rate. By multiplying 10 % to the personnel and O & M equipment cost in Year 2003, the estimated required O & M cost is 241,000,000 pesos.

Table S.4.7 Required Budget for O& M, MMDA

(Unit: Php '000)

	2003	***Required***
Total	**217,845**	**241,000**
Personnel Cost	108,450	127,000
Maintenance & Other Operating	109,395	114,000
(Capital Outlays)	(101,000)	-

(3) O & M Support Measures and Tools

In addition to the above, improvements for various systems to support and to sustain the above comprehensive O & M system are proposed. They are as follows:

- Document management system
- Pumping station management system
- Solid waste transportation supporting system
- Empowerment of pump diagnosis system
- Manpower resources development
- Installation of additional hydrological equipment
- Introduction of emergency operation and maintenance equipment

4.6 PROJECT COST ESTIMATION

Preliminary project cost for the Master Plan of drainage improvement in the core area is estimated. The project cost consists of costs for main works, compensation, engineering services, administration, and contingency.

(1) Basic Conditions

The basic conditions for cost estimation are as follows:

- Unit cost is estimated referring to the unit price obtained from DPWH and recent similar projects in Metropolitan Manila.
- Price level of July 2004 is used with exchange rate of US$1=Php55 = JY110.
- The following ratios of local currency (L/C) and foreign currency (F/C) are considered as actual ratios adopted in the similar drainage projects in Metropolitan Manila.
  - Dredging and additional works: F/C (65%), L/C (35%)
  - Rehabilitation works of drainage pump: F/C (80%), L/C (20%)

(2) Component of Project Cost

The composition of project cost is as summarized below.

Cost of civil works

- Preparatory works cost: 5% of the total cost of civil works
- Main works cost
- Other supporting measures cost
- Miscellaneous cost: 10% of the total cost of preparatory works and main works

Value added tax (VAT)

- Value added tax: 10% of the cost of main works

Resettlement and compensation cost

- Resettlement cost
- Compensation cost for additional works
- Miscellaneous: 5% of the total cost of resettlement and compensation

Cost of administration

- Administration cost: 3% of the total cost of main works

Cost of engineering services

- Engineering services cost: 10% of the total cost of main works

Physical Contingency

- Physical contingency: 10% of the total cost of the above 5 items

Supporting Measures cost

- Cost for BEM and Team ESTERO activities
- Cost for IEC campaign

(3) Main Works Cost

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage channels are estimated as shown in the following tables:

Table S.4.8 Main Works Cost for Improvement and Rehabilitation Works for Drainage Channels

Item			Amount (Million Peso)
Rehabilitation works of drainage channels			1,140.5
N01	Vitas-Binondo-Escolta	Additional works of South Antipolo area	503.0
N02	Quiapo-Aviles	Additional works of channel to Quiapo Pumping Station	307.5
		Additional works for Aviles drainage area	539.2
N04	Maypajo-Blumentritt-Balut	Additional works of Estero de Vitas	18.0
		Additional works of Blumentritt Interceptor	723.2
S01	Libertad-Tripa de Gallina	Additional works for severe inundation area in South Manila	460.1
		Additional works of Libertad pond	522.0
		Additional Works of Dilain/Maricaban Creek area	1,380.8
S02	Balete	Additional works in Estero de Balete	29.1
Total			5,623.4

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage pumping stations are estimated as shown the following tables.

Table S.4.9 Main Works Cost for Improvement and Rehabilitation Works for Drainage Pumping Stations

Item			Amount (Million Peso)
Rehabilitation works of drainage pumping stations			2,129.0
N02	Quiapo-Aviles	Additional works for Aviles drainage area	160.0
S03	Paco-Pandacan-San Andres	Additional works on Perita Creek	160.0
S04	Sta. Clara	Additional works in Sta. Clara drainage basin	160.0
Total			2,609.0

The estimated cost of main works of the master plan projects is shown below.

- **Total main works cost:** **Php8,232.4 million**
- Rehabilitation cost of drainage channels: Php1,140.5 million
- Rehabilitation works of drainage pumping stations: Php2,129.0 million
- Additional works in North Manila: Php2,250.9 million
- Additional works in South Manila: Php2,712.0 million

(4) Resettlement Cost

- **Total resettlement cost:** **Php1,510.6 million**
- Resettlement cost excluding land acquisition cost: Php1,289.6 million
- Land acquisition cost for relocation site: Php221.0 million

(5) Compensation Cost for Additional Works

- **Total compensation cost for additional works:** **Php3.8 million**
- Land acquisition: Php0.8 million
- House compensation: Php3.0 million

(6) Supporting Measures Cost

- **Total cost for BEM and Team ESTERO activities:** **Php 417.8 million**
- **Total cost for IEC campaign:** **Php 71.1 million**

(7) Other Supporting Measures Cost

- **Total other supporting measures cost:** **Php 177.6 million**
- Various management systems: Php 138.5 million
- Additional hydrological equipment: Php 1.5 million
- Emergency operation and maintenance equipment: Php 37.6 million

Note: The cost is included in civil works cost.

(8) Operation and maintenance cost

- **Total O&M cost:** **Php 241.0 million per annum**

(9) Project Cost

In line with the above conditions, the project cost is estimated. The total project cost is Php15,367.3 million as summarized in the following table.

Table S.4.10 Project Cost

Item	Amount (Php million)	Remarks
1. Civil Work	9,703.8	
1.1 Preparatory	411.6	5 % of (1.2)
1.2 Main	8,232.4	
1.3 Other supporting measures	177.6	
1.4 Miscellaneous	882.2	10 % of (1.1+1.2+1.3)
2. VAT	970.4	10 % of (1)
3. Resettlement and Compensation Cost	1,590.1	
3.1 Resettlement cost	1,510.6	
3.2 Compensation cost for additional works	3.8	
3.3 Miscellaneous	75.7	5 % of (3.1+3.2)
4. Government Administration Cost	291.1	3 % of (1)
5. Engineering Services	970.4	10 % of (1)
6. Physical Contingency	1,352.6	10 % of (1+2+3+4+5)
7. Supporting Measure Cost		
7.1 BEM and Team ESTERO	417.8	
7.2 IEC	71.1	
Total	15,367.3	

Total project cost is approximately broken down into the respective 3 phases as follows.

- 1st phase projects: Php 5,503.9 million
- 2nd phase projects: Php 5,419.4 million
- 3rd phase projects: Php 4,444.0 million

It should be noted that the total project cost shown here does not include the operation and maintenance cost (*Php 241.0 million per annum*).

4.7 PREPARATION OF IMPLEMENTATION PLAN

(1) Implementation Agency

The drainage facilities and solid waste management in the core area of Metropolitan Manila are now under the responsibility of MMDA and LGUs; however, the implementation of the proposed Master Plan and priority projects would require the involvement of many agencies including DPWH, MMDA, LGUs and others in order to carry out the drainage improvement project and also require a good coordination among them.

It is necessary to decide the implementing agency for the projects and to establish a coordination committee for smooth implementation of the Master Plan and the Priority Projects. DPWH should have a function to coordinate the related government organizations as the main implementing agency for the Study in order to attain the aim of drainage improvement in the core area of Metropolitan Manila.

(2) Implementation Schedule

The target year of the Master Plan is 2020 and it is scheduled in three phases. Implementation and the disbursement schedules are shown in *Figure S.4.3* and *Table S.4.11*, respectively.

The phasing of the rehabilitation works of drainage channels is shown in *Figure S.4.4* and *Tables S.4.12 and.S.4.13.*

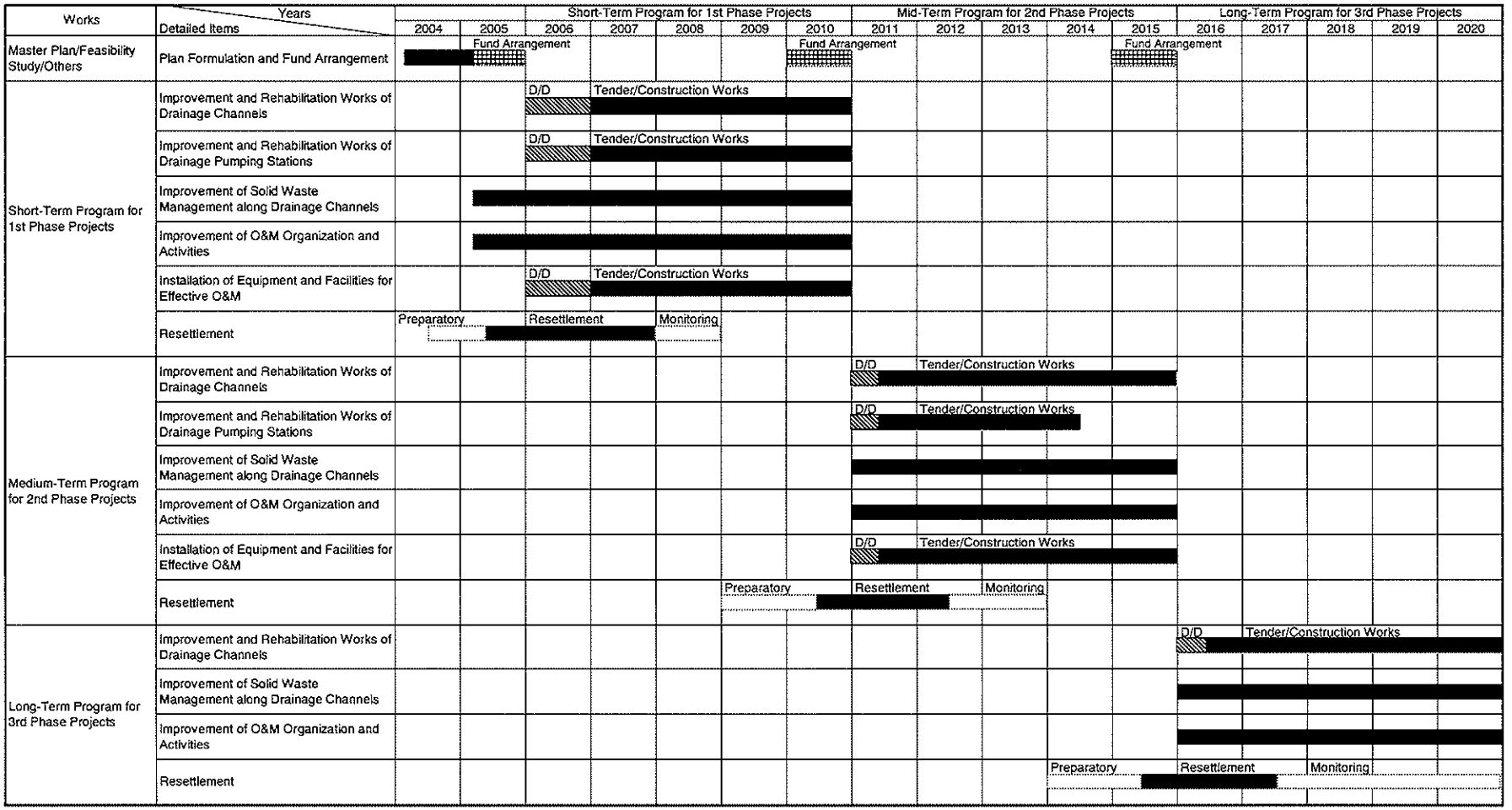


Figure S.4.3 Implementation Schedule of the Master Plan

Table S.4.11 Disbursement Schedule of the Master Plan

Unit: Million Peso

Work Item	Project Cost				Phase 1						Phase 2					Phase 3					Total
	Phase 1	Phase 2	Phase 3	Total	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Civil Works	3,806.9	3,432.0	2,464.9	9,703.8	0	0	0	2315	756.1	735.5	0	156.2	1160.2	1069.3	1046.3	0	117.4	782.7	782.5	782.3	9703.8
1) Preparatory	162.9	142.0	106.7	411.6	0	0	0	162.9	0	0	0	142.0	0	0	0	0	106.7	0	0	0	411.6
2) Main	3,258.8	2,839.5	2,134.1	8,232.4	0	0	0	1921.6	668.6	668.6	0	0	1008.5	925.9	905.1	0	0	711.5	711.4	711.2	8232.4
- Rehabilitation of Drainage Channels	199.8	514.5	426.2	1,140.5	0	0	0	40.0	79.9	79.9	0	0	171.5	171.5	171.5	0	0	142.1	142.1	142.0	1140.5
- Additional Works in North Manila	723.2	1,229.7	298.0	2,250.9	0	0	0	144.6	289.3	289.3	0	0	409.9	409.9	409.9	0	0	99.4	99.3	99.3	2250.9
- Additional Works in South Manla	330.8	971.3	1,409.9	2,712.0	0	0	0	66.2	132.3	132.3	0	0	323.8	323.8	323.7	0	0	470.0	470.0	469.9	2712.0
- Rehabilitation of Pumping Station	2,005.0	124.0	0	2,129.0	0	0	0	1670.8	167.1	167.1	0	0	103.3	20.7	0	0	0	0	0	0	2129.0
3) Other Supporting Measures	39.1	138.5	0	177.6	0	0	0	20.3	18.8	0	0	0	46.2	46.2	46.1	0	0	0	0	0	177.6
4) Miscellaneous	346.1	312.0	224.1	882.2	0	0	0	210.5	68.7	66.9	0	14.2	105.5	97.2	95.1	0	10.7	71.2	71.1	71.1	882.2
VAT	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Resettlement and Compensation Cost	241.8	555.2	793.1	1590.1	95.1	95.1	51.6	0	0	222.1	222.1	111	0	0	317.2	317.2	158.7		0	0	1590.1
1) Resettlement Cost	226.5	528.8	755.3	1510.6	90.6	90.6	45.3	0	0	211.5	211.5	105.8	0	0	302.1	302.1	151.1		0	0	1510.6
2) Compensation Cost for Additional Works	3.8	0	0	3.8	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	3.8
3) Miscellaneous	11.5	26.4	37.8	75.7	4.5	4.5	2.5	0	0	10.6	10.6	5.2	0	0	15.1	15.1	7.6	0	0	0	75.7
Government Administration Cost	114.2	103.0	73.9	291.1	0	0	0	69.4	22.7	22.1	0	4.7	34.8	32.1	31.4	0	3.5	23.5	23.5	23.4	291.1
Engineering Services	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Physical Contingency	492.4	477.7	382.5	1352.6	9.5	9.5	5.2	284.8	93	112.7	22.2	30.3	142.7	131.5	160.4	31.7	30.3	96.3	96.3	96.2	1352.6
			Sub-Total		104.6	104.6	56.8	3132.5	1023.0	1239.6	244.3	333.4	1569.9	1446.7	1764.5	348.9	333.3	1059.1	1058.9	1058.3	14878.4
Supporting Measure Cost	87.2	165.1	236.6	488.9	8.2	9.6	12.4	16.7	18.6	21.7	26.7	29.1	32.6	37.1	39.6	42	45.6	46.9	49.4	52.7	488.9
1) BEM and Team ESTERO	63.3	141.5	213	417.8	3.4	5.9	8.7	12	15.1	18.2	21.3	24.8	28.3	31.8	35.3	37.7	40.2	42.6	45.1	47.4	417.8
2) IEC	23.9	23.6	23.6	71.1	4.8	3.7	3.7	4.7	3.5	3.5	5.4	4.3	4.3	5.3	4.3	4.3	5.4	4.3	4.3	5.3	71.1
			Total		112.8	114.2	69.2	3149.2	1041.6	1261.3	271.0	362.5	1602.5	1483.8	1804.1	390.9	378.9	1106.0	1108.3	1111.0	15367.3

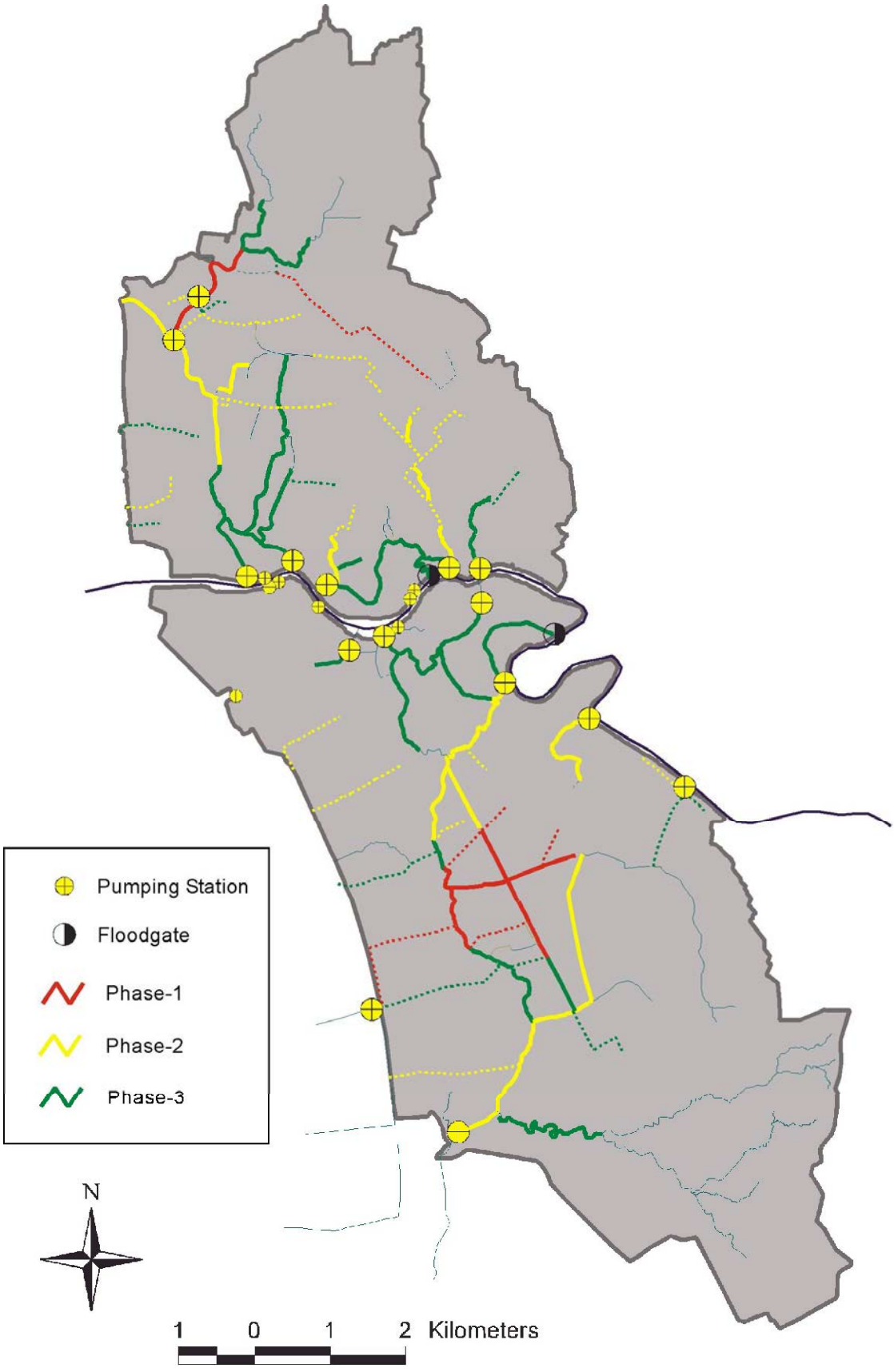


Figure S.4.4 Phasing of Rehabilitation of Drainage Channels

Table S.4.12 Phasing of Rehabilitation Works for Esteros/Creeks

Code	Name of Estero	Total Dredging Length (m)	Total Dredging Volume (m^3)	Portion	Dredging Length (m)	Dredging Volume (m^3)	Phase 1	Phase 2	Phase 3	Number of Buildings
NE01	Estero De Vitas	1,992	109,547		1,992	109,547		x		51
NE02	Estero De Sunog Apog/ Maypajo	3,172	111,401	1	1,827	91,475	x			37
				2	1,345	19,925			x	67
NE03	Casili Creek	901	6,025		901	6,025			x	0
NE04	Estero Dela Reina	2,843	31,254	1	1,946	20,515			x	15
				2	897	10,739		x		97
NE05	Estero De Binondo	922	7,310		922	7,310			x	0
NE06	Estero De Magdalena	1,512	18,895		1,512	18,895			x	35
NE07	Estero De San Lazaro	2,324	34,983		2,324	34,983			x	31
NE08	Estero De Kabulusan	690	8,371		690	8,371		x		5
NE12	Estero De Quiapo	903	14,064		903	14,064		x		19
NE13	Estero De San Sebastian	379	1,685		379	1,685			x	5
NE14	Estero De San Miguel/ Uli Uli	2,674	36,008		2,674	36,008			x	46
NE16	Estero De Aviles	345	1,783		345	1,783			x	0
NE17	Estero De Sampaloc I	659	9,397		659	9,397		x		0
NE18	Estero De Sampaloc II	506	4,786		506	4,786		x		1
NE19	Estero De Calubcob	337	1,136		337	1,136		x		4
NE20	Estero De Valencia	1,128	18,923		1,128	18,923			x	130
SE03	Estero De Balete	550	4,601		550	4,601			x	11
SE05	Santa Clara Creek	1,392	16,116		1,392	16,116		x		10
SE06	Estero De Paco	1,771	17,397		1,771	17,397			x	210
SE07	Estero De Concordia	1,070	24,702		1,070	24,702			x	0
SE08	Estero De Pandacan	3,878	27,629	1	1,929	18,036			x	51
				2	292	2,446		x		0
				3	1,657	7,148			x	1
SE09	Estero de Tripa de Gallina	7,538	224,912	1	1,929	115,819		x		315
				2	1,515	48,384			x	204
				3	1,247	28,882	x			230
				4	419	6,580			x	17
				5	2,428	25,246		x		92
SE10	Perlita Creek	922	3,264		922	3,264		x		12
SE11	PNR Canal	2,654	6,468	1	1,883	4,969	x			9
				2	771	1,499			x	105
SE12	Calatagan Creek I	1,711	13,162		1,711	13,162	x			6
SE16	Makati Diversion Channel I	814	11,167		814	11,167		x		43
SE17	Makati Diverson Channel II	1,993	28,302		1,993	28,302		x		0
SE18	Dilain Creek/ Maricaban Creek I	2,151	45,823		2,151	45,823			x	9
Total		47,733	839,110		47,733	839,110	138,489	360,400	340,222	1,868

Table S.4.13 Phasing of Rehabilitation Works for Drainage Main

Code	Name of Drainage Main	Total Length (m)	Total Volume (m^3)	Portion	Length (m)	Volume (m^3)	Phase 1	Phase 2	Phase 3	Stop Log Gate
ND01	Pacheco	1157	1879		1157	1879			x	x
ND02	Lakandula	873	3520		873	3520		x		x
ND03	Zaragosa Sub	429	279		429	279			x	
ND04	Buendia	511	594		511	594		x		x
ND05	Blumentritt Interceptor	2775	10574	1	183	861			x	x
				2	2592	9713	x			x
ND07	Pampanga-Earnshaw Sub	1040	1624	1	653	606		x		x
				2	386	1017			x	x
ND08	Solis-Tecson	1424	2303	1	61	47			x	x
				2	1363	2256		x		x
ND09	South Antipolo	1379	7619		1379	7619		x		x
ND11	Kabulusan	366	1935		366	1935		x		x
ND12	Tayuman	1598	3755		1598	3755		x		x
ND13	Fugoso	669	1266		669	1266			x	x
ND14	Severino Reyes	646	319		646	319		x		x
ND15	Lepanto-Gov. Forbes	1160	7817		1160	7817		x		x
ND16	Lepanto-Josefina	1063	1434		1063	1434		x		x
ND17	Economia	824	2031		824	2031		x		x
ND18	Washington-P. Margal	212	485		212	485		x		x
ND19	Visayas	674	1103		674	1103			x	x
SD01	Padre Faura	1159	901		1159	901		x		x
SD02	Remedios	1348	3192		1348	3192		x		x
SD04	Makati Headrace-I	626	2280		626	2280		x		x
SD05	Makati Headrace-II	393	374		393	374			x	x
SD06	Zobel Orbit	1219	505		1219	505			x	
SD07	Onyx	414	456		414	456		x		
SD08	Estrada	518	682		518	682		x		
SD09	Zobel Roxas	1155	2120		1155	2120	x			
SD10	Faraday	817	99		817	99	x			
SD11	Pasong Tamo	543	911		543	911	x			
SD12	SSH-Way	1108	311		1108	311			x	
SD13	Vito Cruz	1450	521		1450	521			x	x
SD14	Buendia Outfall	1992	7152		1992	7152	x			x
SD15	Libertad Outfall	1796	2816		1796	2816			x	x
SD16	EDSA Outfall	1731	10142		1731	10142		x		x
SD17	Dolores	434	-		434	-			x	
Total		33502	80997		33502	80997	19995	50023	50023	

4.8 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

(1) Environmental Study on Existing Environmental Conditions for Drainage Improvement Works

An Initial Environmental Examination (IEE) is carried out to provide the following information through preparation of environmental impact matrix, screening, and scoping:

- To identify possible environmental impact caused by implementation of the proposed projects and programs based on available data and information and limited field reconnaissance
- To recommend necessary preventive measures and modification of the projects and programs, if necessary
- To suggest necessary environmental impact study such as EIA (or EIS) at feasibility study stage

The IEE is conducted based on the available data and information, and the field surveys conducted are as follows:

- Geology and soil
- Identification of water pollution sources along esteros/creeks (inventory of industries)
- Water quality test of esteros at 5 spots along esteros/creeks
- Sediment quality test at 5 spots along esteros/creeks
- Flora and fauna
- Socio-economic conditions
- Distribution of informal settlers in and along esteros/creeks（Tripa de Gallina and Sunog Apog/Maypajo：10 km）
- Informal house buildings in esteros（other esteros：45 km）

(2) Analysis of Environmental Impact

- Preparation of environmental checklist
- Preparation of environmental impact matrix
- Preparation of screening and scoping

4.9 EVALUATION OF THE PROJECTS

(1) Economic Evaluation

1) Benefit of the Project

The components of benefit in this analysis were selected considering the inventory of the existing facilities and data availability in Metropolitan Manila. They are as follows:

Direct Damage

- Building Unit

  (Residential Houses and Buildings of Business Establishment, Educational and Health Facilities)
- Assets

  (Household Effects, Depreciable Assets of Business Establishments, Inventory Stocks of

Business Establishments)

- Public Infrastructure

Indirect Damage

- Trade Loss (Household and Business)
- Public Service Disruption
- Traffic Disruption
- Extra Expenses for Emergency
  (Cleaning at Households & Businesses, Assistance for affected people)

The results of the flood damage by return period estimates are summarized in the following tables:

Table S.4.14 Flood Damage by Return Period (Without Project, All Study Area)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	10,796	13,651	18,165	25,067	29,816	32,051
1. Residence - House	1,836	2,446	3,304	4,909	5,852	6,336
2. Residence - Household Effects	976	1,311	1,786	2,654	3,210	3,488
3. Business Establishments	5,424	6,658	8,767	11,559	13,684	14,627
3-1 Manufacturing	1,388	1,718	2,299	2,996	3,564	3,815
3-2 Commerce (Wholesale & Retail Trade)	1,524	1,898	2,546	3,429	4,124	4,427
3-3 Hotel and Restaurants	863	1,056	1,375	1,786	2,091	2,231
3-4 Financial / Insurance / Real Estate Business	850	1,024	1,304	1,733	2,020	2,149
3-5 Educational Facilities	190	228	295	380	443	471
3-6 Medical Facilities	609	734	949	1,234	1,441	1,534
4 Infrastructure	2,560	3,237	4,308	5,944	7,070	7,600
B. Indirect Damage	5,079	6,478	8,604	11,987	14,255	15,307
5 Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	3,173	3,962	5,249	7,108	8,439	9,051
6 Traffic Disruption	5	7	9	12	12	13
7 Assistance and Calamity Fund Extended	0	0	0	0	0	0
8 Cost for Alternative Activities	1,901	2,509	3,346	4,866	5,805	6,244
C. Total	15,875	20,129	26,769	37,053	44,071	47,359

Source: The Study Team

Table S.4.15 Flood Damage by Return Period (With Master Plan, All Study Area)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	626	937	1,432	2,667	6,500	8,481
1. Residence - House	35	40	138	306	939	1,337
2. Residence - Household Effects	16	19	60	143	424	612
3. Business Establishments	427	656	895	1,586	3,595	4,521
3-1 Manufacturing	122	185	253	436	952	1,191
3-2 Commerce (Wholesale & Retail Trade)	120	184	251	440	987	1,247
3-3 Hotel and Restaurants	65	100	136	244	575	721
3-4 Financial / Insurance / Real Estate Business	56	88	119	223	532	676
3-5 Educational Facilities	16	24	33	59	133	165
3-6 Medical Facilities	49	75	103	184	417	521
4. Infrastructure	149	222	340	632	1,541	2,011
B. Indirect Damage	257	376	623	1,170	2,960	3,919
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	212	322	465	845	1,991	2,556
6. Traffic Disruption	1	1	1	1	1	3
7. Cost for Alternative Activities	45	54	157	324	967	1,360
C. Total	884	1,313	2,055	3,837	9,459	12,400

Source: The Study Team

2) Cost of the Project

The project financial cost is converted to economic cost:

- Economic cost:

  Financial Cost x Conversion Factors
  (Actual cost in market value)

- Conversion Factor 1: Transfer Payments

  Economic Cost = 86% of Financial cost

  where, the cost for land acquisition is also converted at same rate, in this analysis, assuming the necessary lands for right-of-way and resettlement site would be acquired from private sector.

- Conversion Factor 2 : Foreign Exchange Shadow Price Rate (or Shadow Exchange Rate, SER)

  For Foreign Currency Portion, 1.2 times of the official rate is adopted. This rate is based on NEDA guideline

- Conversion Factor 3 : Opportunity Cost of labor (or Shadow Wage Rate, SWR)

  In this analysis, the adjustment is applied based on the NEDA guideline as follows

  - SWR of Unskilled Labor: 0.6 times of market wage rate
  - SWR of Skilled Labor: 1.0 times of market wage rate

Being subject to the guidance from and discussions with the engineering experts of agencies concerned and the Study Team, annual operation and maintenance cost is assumed to be 110% of current expenditure of MMDA for 2005-2020 to hold the status quo. After project period (year 2020), these cost are excluded from this economic analysis, because these costs are necessary under both ”with” and “without” project situation. After 2020, only maintenance cost for additional civil works proposed in the Master Plan is considered for 2005-2040 in economic analysis.

And also, the project cost for supporting measures are excluded from this economic analysis, because there was not enough information to quantify the effect and benefit derived from the supporting measures.

The project cost is shown in the following table:

Table S.4.16 Project Cost (Financial and Economic Cost)

Unit : Php million

Item	Financial Cost	Economic Cost
1. Civil Work	9,703.8	9,430.2
2. VAT	970.4	0.0
3. Resettlement and Compensation Cost	1,590.1	1,367.5
4. Government Administration Cost	291.1	250.3
5. Engineering Services	970.4	942.9
6. Physical Contingency	1,352.6	1,282.6
7. Supporting Measure Cost	488.9	0.0
8. Operation Cost (2005-2020)	0.0	3,316.2
9. Maintenance Cost (2005-2040)	0.0	1,269.4
Total	15,367.3	17,859.1

Source: The Study Team

Note : Cost for Supporting Measures are excluded. Details may not add up to totals due to rounding.

3) Economic Viability

The Master Plan was evaluated from the economic viewpoint by figuring out the economic viability, comparing the economic benefit and the economic cost in terms of economic internal rate of return (EIRR), benefit/cost ratio (B/C), and net present value (NPV = B – C, or Benefit minus Cost).

All the monetary calculations were based on the following parameters either predetermined or using assumptions.

Project Duration

- Project Start-up : 2005
- Project Life Span (Economic Life) : 30 years after completion of the work in Short-Term
- Project phase: The 1st phase starts in 2005 and continues to 2010; the 2nd phase works are facilitated from 2011 to 2015; the 3rd phase works are facilitated from 2016 to 2020; then, beyond 2020, operation and maintenance works continue to 2040.

Timing of Accruing Benefits

- 25% of annual average benefit will appear after the first phase.
- 50% of annual average benefit will appear after the second phase.
- The matured annual average benefit will appear after the third phase, i.e., completion of all phases of civil works.

Price Level

- Costs and benefits of the projects are set down at the beginning of 2004.

Social Discount Rate (SDR)

- Based on the guideline of NEDA for basic infrastructure projects, SDR is applied at 15% in this analysis.

Prevailing Exchange Rate

- Php55 per US$ and JPY110 per US$ at the official rate in market as same as the analysis of Master Plan

Depreciation, Financial Charges, Interest and Amortization

- In general, financing of the project is not relevant to the economic evaluation. These financial items are independent of the economic value of the project. To ensure that only feasible projects are financed, investments should be subjected to cost-benefit analysis removed from financing considerations. Only after a project is determined feasible should terms of financing be incorporated to evaluate possible benefits derived from relative favorable (e.g., concessional) loan terms. From these points of view, depreciation (residual value) of waterways and pumping stations, and financial cost or charges are not estimated in this analysis.

The calculation of NPV, B/C, EIRR was based on the annual cash flow that was prepared from the above-said economic cost and the annual average benefit discussed in accordance with the implementation schedule or annual disbursement schedule. The economic viability of the optimum plan was thus figured out as follows.

Table S.4.17 Results of Economic Analysis (Future Condition, M/P Projects)

NPV	Php 27,595 milion
B/C	5.2
EIRR	42.8%

Source: The Study Team

4) Sensitivity Analysis

In this context, the sensitivity analysis was tested in the following relevant parameters guided by NEDA in consideration of sensitive factors for project feasibility.

- Assumption I : Increase in projected costs by 10% and 20%
- Assumption II: Decrease in revenues by 10% and 20%
- Assumption III: Combination of Cases I and II

In addition to the above NEDA assumptions, another case that the benefit decreased to 50% of original estimate was also tested for reference.

Table S.4.18 Results of the Sensitivity Analysis 1 (NPV, Future Condition, M/P Projects)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	27,595	24,176	20,756	10,497
	+10%	26,935	23,515	20,096	9,837
	+20%	26,275	22,855	19,436	9,176

Source: The Study Team

Table S.4.19 Results of the Sensitivity Analysis 2 (B/C, Future Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	5.2	4.7	4.1	2.6
	+10%	4.7	4.2	3.8	2.4
	+20%	4.3	3.9	3.5	2.2

Source: The Study Team

Table S. 4. 20 Results of the Sensitivity Analysis 3 (EIRR, Future Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	42.8%	40.3%	37.8%	28.6%
	+10%	40.6%	38.2%	35.8%	27.0%
	+20%	38.6%	36.4%	34.0%	25.5%

Source: The Study Team

(2) Project Evaluation

1) Technical Aspect

The estimated reduction of the floods and inundation damages by the project is evaluated as a part of the impact from the technical aspect. Though 87,000 houses and a half of the roads (1,389 km) were affected in the 1999 floods and inundation, affected population numbers and road networks will be significantly reduced by the implementation of the project due to the reduction of the depth and duration of the floods and inundation.

2) Economic Aspect

Though social infrastructure projects such as flood control and drainage improvement works are in general put into implementation even at the lower EIRR, compared with other productive projects, the Master Plan shows a very high viability of 42.8% in EIRR (Future Condition), likewise resulting in high values of B/C (5.2%) and NPV (Php27,595 million) for the conceivable reason that socio-economic needs for flood prevention in the study area where the central function of the political and economic activity locates will augment to a maximum degree.

The reason of high viability is that there are already numerous drainage facilities: 15 major drainage pumping stations, 74 km esteros/creeks, 35 km drainage mains/outfalls and other small drainage network in Metropolitan Manila. However, the construction cost of these tremendous investments are not considered in this economic analysis, because these costs shall be excluded as “sunk cost” in conventional economic analysis on public infrastructure project. In other words, taking advantage of these infrastructure heritages, it is possible to output the most effective result with minimum additional investment for these kinds of infrastructure.

In this context, the Master Plan can be justified from the economic viewpoint to take a next step in accordance with the proposed schedule.

3) Financial Aspect

The master plan would be effective to mitigate the damages caused by floods and inundation in the capital area and feasible from technical, economic, and social and environmental aspects. It is surely worthwhile for the Government of the Philippines to consider the increase of budgetary allocation to the floods and drainage improvement in the capital area.

When the annualized cost of the proposed cost of Master Plan is compared to the average amount of total expenditure of MMDA and 6 LGUs for the past 6 years, it is fairly huge and requires almost 1.5 times of annual budget in order to implement the Master Plan.

While, on the assumption that the JBIC loan or other resources of ODA would be appropriated to the Master Plan, the required share of the Government of the Philippines is equivalent to around 31% to present expenditures, and that the said burden is not prohibitive level of their expenditures from the aspect of the financial status of the relevant authorities.

The Government of the Philippines needs to consider the financial arrangement for the implementing agencies to implement the Master Plan.

4) Social and Environmental Aspect

Major issues related to social and environmental aspects are as follows:

- The rehabilitation of the drainage channels proposed in the Master Plan requires the

relocation of informal settlers occupying an estimated 1,900 houses in the drainage channels.

- The rehabilitation works also require dredging of a huge volume of bottom deposits, which was estimated to be about 920,000 m^3 and preparation of disposal sites for dredged materials.

4.10 Preparation of Guideline for Social Framework of Resettlement

In order to recover the drainage capacity of the existing drainage channels, the relocation of informal settlers who live in house buildings within the drainage should be required. For removal of informal houses buildings (Phase 1: 285, Phase 2: 665, Phase 3: 950) and relocation of informal settlers, the following issues should be considered:

- Every effort should be made to avoid unwilling relocation such as “summary eviction”.
- Participation of project affected people on creating better solution for resettlement is crucial.
- Clarification of the responsibility and fulfillment of the mandate of the implementing agency, and establishment of a coordination committee consisting of relating agencies: LGUs, MMDA, DPWH, NHA, HUDCC etc., is necessary.
- Establishment of uniformed standard in application of RA 7279 is recommended.
- Resettlement sites with basic infrastructure are fundamental.
- A separate third party Monitoring team that can monitor the entire resettlement operation throughout the project from the initial stage of the project should be established.
- Dynamics and capacity of the people should be considered as resources.

5. PRIORITY PROJECTS

The projects proposed for the Phase 1 in the Master Plan are selected as the Priority Projects, because the projects selected for the Phase 1 are proposed to improve the inundation conditions (depth and duration) of the severest inundation areas in both North Manila and South Manila.

5.1 DRAINAGE FACILITIES

The Projects proposed for 1st Phase are selected as the priority projects for drainage improvement in the core area. The Priority Projects are planned as the measures for mitigation of severe floods/inundation damage areas both in North Manila and in South Manila. They are:

(1) Rehabilitation Works of Drainage Channels

- Dredging of Esteros/Creeks : 139,000 m^3
  - Estero de Sunog Apog/Maypajo (partially)
  - Estero de Tripa de Gallina (partially)
  - PNR Canal (partially)
  - Calatagan Creek I
- Declogging of Drainage Mains: 20,000 m^3
  - Blumentritt Interceptor
  - Buendia Outfall
  - Zobel Roxas D.M.
  - Faraday D.M.
  - Pasong Tamo D.M.
  - Related Works:
- Related Works:
- Relocation of Informal Settlers: 825 families estimated (15% of 5,500 families)

(2) Rehabilitation Works of Drainage Pumping Stations

- Rehabilitation: 12 Pumping Stations
  (Quiapo, Aviles, Valencia, Binondo, Escolta, Tripa de Gallina, Pandacan, Paco, Sta.Clara, Libertad, Makati, Balete)

(3) Additional Works for North Manila

- Additional works for Aviles drainage area
  - Increasing the pump capacity (3 m^3/s) at Aviles Pumping Station
- Additional works of Blumentritt Interceptor
  - Remedial works of existing Blumentritt Interceptor
  - Construction of additional interceptor

(4) Additional Works for South Manila

- Additional works for the severe inundation area in South Manila
  - Additional Box Culvert (B.C) along Zobel Roxas D.M.
  - Additional B.C. along Faraday D.M.

5.2 SUPPORTING MEASURES

1) Improvement of Operation and Maintenance Organization and Activities and Promotion of Community-Involved Activities
   - Improvement of the existing O&M organization and activities including establishment of Community-Involved O&M
   - Community-Involved Solid Waste Management
2) Installation of Additional Hydrological Equipment
3) Introduction of Emergency Operation and Maintenance Equipment
4) Preparation of Guideline for Resettlement

6. FEASIBILITY STUDY

6.1 COMPOSITION OF PRIORITY PROJECTS

The component of the projects is as follows:

(1) Rehabilitation Works for Drainage Channels

- Dredging of Esteros/Creeks: 138,000 m^3
- Declogging of Drainage Mains: 20,000 m^3
- The dredging works require the relocation of 285 informal house buildings (or structures) and informal settlers (825 families estimated, 15% of 5,500 families)

(2) Rehabilitation Works for Drainage Pumping Stations

- Rehabilitation of the 12 Pumping Stations (Quiapo, Aviles, Valencia, Binondo, Escolta, Tripa de Gallina, Pandacan, Paco, Sta.Clara, Libertad, Makati, Balete)

(3) Related (or remedial) and Additional Works for both North Manila and South Manila

- Additional works for Aviles drainage area
- Additional works of Blumentritt Interceptor
- Additional works for the severe inundation area in South Manila

(4) Improvement of O & M Organizations/Activities and Promotion of Community-Involved Activities

- Improvement of the existing O&M organization and activities including establishment of Community-Involved O&M
- Community-Involved Solid Waste Management

(5) Others

- Experiment at pilot barangays
- Installation of additional hydrological equipment
- Introduction of emergency operation and maintenance equipment
- Preparation of guideline for resettlement

6.2 PRELIMINARY DESIGN OF DRAINAGE FACILITIES

(1) Improvement and Rehabilitation of Drainage Channels

1) North Manila: Maypajo-Blumentritt-Balut Drainage Block

a) Estero de Sunog Apog

- Dredging (Clearing): 91,600 m^3 (for a total length of 1,841 m)

b) Blumentritt Interceptor

- Raising/modification of cover of maintenance holes: 20 holes
- Installation of stop log gate: 8 sections
- Declogging: 9,800 m^3 (for a total length of 2,655 m)
- Construction of additional interceptor by box culvert: 2,570 m
- Installation of maintenance hole: 51 places
- Widening of narrow sections of existing box culvert: 2 sections with a total length of 200 m
- Installation of inlet for road surface flow: 10 sections
- Affected buildings by the construction of additional interceptor: Some house buildings

The dimension of the additional box culvert for Blumentritt interceptor is shown in *Table S.6.1*.

Table S.6.1 Dimensions of Additional Box Culvert for Blumentritt Interceptor

Strech	Length	Culvert Dimension
Outlet - Intersection of Abucay street	564 m	Width 3.4 m × height 2.6 m × 2 lanes
Intersection of Abucay st. - Intersection of Chinese cemetery	1,567 m	W 3.6 m × h 2.7 m × 1 lane
Intersection of Chinese cemetery - Intersection of Calamba st.	439 m	W 2.3 m × h 2.4 m × I lane

The design discharges for additional culvert are as follows with a 3-year return period of design scale.

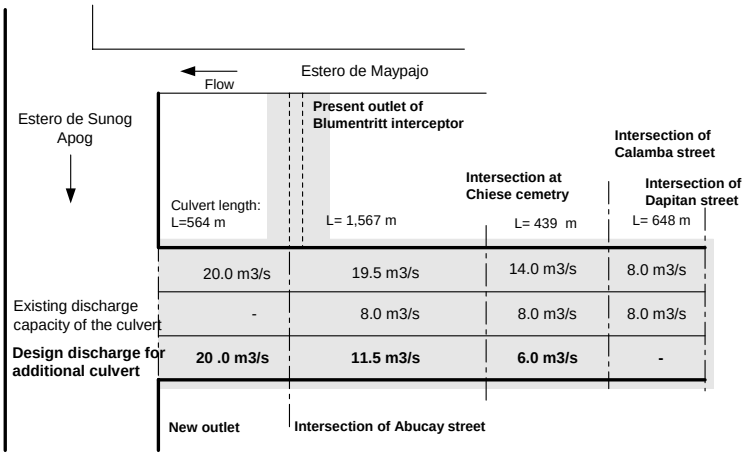


Figure S.6.1 Design Discharge of Additional Box Culvert for Blumentritt Interceptor

2) South Manila: Libertad-Tripa de Gallina Block

a)Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

- Dredging (Clearing) of Tripa de Gallina: 28,900 m^3 (for a total length of 1,190 m)
- Dredging (Clearing) of PNR canal: 5,000 m^3 (for a total length of 1,862 m)
- Dredging (Clearing) of Calatagan Creek I: 13,200 m^3 (for a total length of 1,686 m)
- Resettlement prior to the dredging works: About 700 families (counted in the EIA Study)

b) Buendia Outfall

- Raising/modification of cover of maintenance hole: 22 holes
- Installation of stop log gate: 6 sections
- Declogging: 7,200 m^3 (for a total length of 1,960 m)

c) Zobel Roxas Drainage Main

- Raising/modification of maintenance hole: 3 holes
- Declogging: 2,200 m^3 (for a total length of 864 m)
- Construction of additional box culvert: 495 m
- Installation of maintenance hole: 10 places

The dimension of the additional box culvert for Zobel Roxas Drainage Main is shown in *Table S.6.2.*

Table S.6.2 Dimensions of Additional Box Culvert for Zobel Roxas D.M.

Strech	Length	Culvert Dimension
Outlet+369 m - South Superhighway	270 m	Width 1.7 m × height 1.6 m × 2 lanes
South Superhighway - PNR	65 m	W 1.8 m × h 1.5 m × 2 lanes
PNR – upper end	160 m	W 2.3 m × h 1.5 m × 2 lanes

d) Pasong Tamo Drainage Main

-Declogging: 900 m^3 (for a total length of 550 m)

e) Faraday Drainage Main

- Declogging: 100 m^3 (for a total length of 713 m)
- Construction of additional box culvert: 1,314 m
- Installation of maintenance hole: 26 places
- Affected buildings by the construction of additional box culvert:Some house buildings

The dimension of the additional box culvert for Faraday Drainage Main is shown in *Table S.6.3.*

Table S.6.3 Dimensions of Additional Box Culvert for Faraday D.M.

Strech	Length	Culvert Dimension
Existing Faraday DM route		
Intersection of Dian st. - Intersection of Arthur st. (diversion point)	228 m	Width 1.8 m × h 1.4 m × 1 lane
Intersection of Arhtur st. (diversion point) - South Superhighway	100 m	W 2.2 m × h 1.7 m × 2 lanes
South Superhighway - PNR canal	72 m	W 1.8 m × h 1.4 m × 2 lanes
Finlandia and Arthur streets route		
Outlet in Finlandia st. - diversion point	914 m	W 3.5 m × h 1.7 m × 1 lane

(2) Improvement of Drainage Pumping Stations

Rehabilitation works for the 12 major drainage pumping stations is selected as priority projects. They are listed as follows:

- Aviles

  At Aviles pumping station it is planned to increase pump capacity of 3 m^3/s together with the rehabilitation works.
- Quiapo
- Valencia
- Pandacan
- Paco
- Sta.Clara
- Tripa de Gallina
- Libertad
- Makati
- Binondo
- Escolta and
- Balete

The drainage capacities of the existing 12 pumping stations are principally kept by means of repair and/or replacement of pump equipment and appurtenant facilities complying with the extent of mechanical and electrical superannuation. The existing and proposed drainage capacities of the 12 stations with the scales of 10-year return period applied in the original design are shown in the following table.

Table S.6.4 Drainage Capacity of Pumping Stations

Pumping station	Construction Year and (Operation Hours as of June 2004)	Existing discharge capacity (m^3/s)	Proposed discharge capacity (m^3/s)	Remarks
Aviles	1976 (14,650)	15.6	18.6	+ 3 m^3/s
Quiapo	1976 (15,830)	10.8	10.8	No change
Valencia	1976 (10,790)	11.8	11.8	No change
Pandacan	1976 (10,890)	4.4	4.4	No change
Paco	1977 (16,630)	7.6	7.6	No change
Sta. Clara	1977 (7,420)	5.3	5.3	No change
Tripa de Gallina*1	1977 (8,010)	57.0	57.0	No change
Libertad*1	1977 (12,880)	42.0	42.0	No change
Makati	1984 (4,030)	7.0	7.0	No change
Binondo	1985 (8,220)	11.6	11.6	No change
Balete	1988 (140)	3.0	3.0	No change
Escolta	1982 (360)	1.5	1.5	No change

Note: *1 indicates installed pump is horizontal one and others, vertical one.

Manual of Rehabilitation of Pump Equipment and Appurtenant Facilities, Ministry of Land, Infrastructure and Transport (MLIT), Japan will be referred to in consideration of rehabilitation works.

As reference, average working life of pump equipment and electrical parts is summarized from both the aspects of physical and functional in the following table, which is from the above manual by MLIT, Japan.

Table S.6.5 Working Life of Pump Equipment and Appurtenant Facilities

System/Part	Equipment/Facilities	Physical Working Life (year) *1	Functional Working Life (year)*2
Main pump equipment	Main pump	40	30
	Main discharge pipe	40	40
	Valve	40	25
Engine	Prime mover for diesel	40	27
	Reduction gear	40	30
Fuel system	Fuel transfer pump	20	20
	Storage tank	30	30
Cooling system	Cooling water pump (vertical/horizontal)	20	18
	Cooling water pump (submergible)	10	10
Air supply system	Air compressor	20	17
Electrical system	Panel	20	18
	Generator	40	18
Trash rake	Trash rake/conveyor/ screen	20	20
Crane	Overhead crane	40	40
Flood gate	Sluice gate	40	40

Note: *1: Working life based on life cycle cost (physical life), *2; Working life to be replaced by working reliability (functional life)

Eight out of the 12 stations were constructed in the 1970s and the others in the 1980s. They have already been operated for 20 to 30 years. The annual operation hours exceed 500 hours at some stations. Consequently, mechanical and electrical superannuation at the 12 stations are being considerably progressed. According to the average working life indicated in the above table, it can be said that some pump equipment and electrical apparatus already exceeded their functional working lives.

The pump equipment and apparatus at 4 stations (Aviles, Quiapo, Valencia and Tripa de Gallina) are in serious condition and require urgent rehabilitation.

Meantime, the pumps at the 2 stations of Escolta and Balete are a submergible pump type and it is proposed in the Master Plan to convert to gate pump type by using existing drainage gate.

1) Technical Investigation and Analysis of Pumping Station

In the next implementation stage, a further careful and thorough technical investigation and analysis is to be conducted for formulation of a detailed rehabilitation program. Accordingly, the detailed rehabilitation work items will be finalized based on the results of the technical investigation and analysis.

The rehabilitation works of drainage pumping stations consist of 1) repair and replacement works of pump equipment and appurtenant facilities, and 2) supply of spare parts and consumables. The rehabilitation work items by each part are summarized in the following table.

Table S.6.6 Tentative Detailed Work Items to be taken Up in Rehabilitation

No.	Pump Equipment/Appurtenant Facilities	Aviles	Quiapo	Valencia	Pandacan	Paco	Sta. Clara	Tripa de Gallina	Libertad	Makati	Binondo	Balete	Escolta
1	Main Pump	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	●	●
2	Reduction Gear	●	●	●	●	●	●	●	●	●	●	N/A	N/A
3	Butterfly Valve (inclu. replace of actuator	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	N/A	N/A
4	Flap Valve	○	○	○	○	○	○	○	○	○	○	●	●
5	Diesel Engine for Main Pump	●	●	●	●	●	●	●	●	●	●	N/A	N/A
6	Generator Panel	●	●	●	●	●	●	●	●	●	●	○	○
7	Diesel Engine for Generator	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○
8	Vacuum Pump (for priming)	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A
10	Clear Water Pump	●	●	●	●	●	●	●	●	●	●	N/A	N/A
11	Cooling & Sealing Water Pump	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A
12	Cooling Water Pump for Gen.	●	●	●	●	●	●	●	●	●	●	N/A	N/A
13	Fuel Transfer Pump	●	●	●	●	●	●	●	●	●	●	N/A	N/A
14	Cooling Tower	●	●	●	●	●	●	●	●	●	●	N/A	N/A
15	Air Compressor	●	●	●	●	●	●	●	●	●	●	N/A	N/A
16	Air Reservoir Tank	□	□	□	□	□	□	□	□	□	□	N/A	N/A
17	Ventilating Fan	●	●	●	●	●	●	●	●	●	●	N/A	N/A
18	Fuel Storage Tank	□	□	□	□	□	□	□	□	□	□	N/A	N/A
19	Fuel Service Tank	□	□	□	□	□	□	□	□	□	□	N/A	N/A
20	Cooling Water Tank	□	□	□	□	□	□	□	□	□	□	N/A	N/A
21	W. L. Gauge at Inlet (ultrasonic type)	●	●	●	●	●	●	●	●	●	●	●	●
22	W. L. Gauge at Outlet (ultrasonic type)	●	●	●	●	●	●	●	●	●	●	●	●
23	Automatic Trash Rake and Screens	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	N/A	N/A
24	Horizontal Conveyor	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	N/A	N/A
25	Inclined Conveyor	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	N/A	N/A
26	Hopper	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	N/A	N/A
27	Conveyor Pit Drain Pump	●	●	●	●	●	●	●	●	●	●	N/A	N/A
28	Pump Room Drain Pump	●	●	●	●	●	●	●	●	●	●	N/A	N/A
29	Overhead Crane	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	N/A	N/A
30	Flood Gate/Control Panel	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	▲	▲
31	Electric Panel	●	●	●	●	●	●	●	●	●	●	●	●

Legend:

□: Inspection
▲: Overhaul
○: Repair
●: Replacement
- : No action
N/A: Not applicable

2) Urgent Rehabilitation Works for 4 Stations: Aviles, Quiapo, Valencia and Tripa de Gallina

The contents of the rehabilitation works required are as follows.

Main pump and discharge valve

- For vertical pumps of Quiapo, Aviles and Valencia, vertical pumps including main pipe will be repaired based on the prior investigation and analysis result.
- For horizontal pumps of Tripa de Gallina, horizontal pumps will be repaired based on the prior investigation and analysis result.
- Discharge valve, shaft, shaft seal, prime detector, submerged bearing and radial/thrust bearing will be replaced with new ones.

Gear box and engine

- Gear box and diesel engine for the main pump and auxiliary equipment will be replaced.
- All the existing engines including air starting system, cooling water system, lubrication system, etc., will be replaced.

Electrical system and generator

- All the existing electrical system including main electrical panels, local panels, cable/wires trays, etc., will be replaced.
- Generator equipment will be repaired including panels.

Automatic trash removal equipment

- Automatic trash rake and screen and horizontal/inclined conveyor will be repaired including replacement of some minor parts.

Water level gauging

- The existing water level gauging will be replaced by new one of ultrasonic type.

3) Urgent Rehabilitation for 6 Stations: Pandacan, Paco, Sta. Clara, Libertad, Makati and Binondo

Main pump and discharge valve

- For vertical pumps of Pandacan, Paco, Sta. Clara, Makati and Binondo, vertical pumps will be repaired based on the prior investigation and analysis result.
- For horizontal pumps of Libertad, it will be repaired based on the prior investigation and analysis result.
- Discharge valve, shaft, shaft seal, prime detector, submerged bearing and radial/thrust bearing will be replaced with new ones.

Gear box and engine

- Gear box and diesel engine for the main pump and auxiliary equipment will be replaced.
- All the existing engines including air starting system, cooling water system, lubrication system, etc., will be replaced.

Electrical system and generator

- All the existing electrical system including main electrical panels, local panels, cable/wires trays, etc., will be replaced.
- Generator equipment will be repaired including panels.

Automatic trash removal equipment

- Automatic trash rake and screen and horizontal/inclined conveyor will be repaired including replacement of some minor parts.

Water level gauging

- The existing water level gauging will be replaced by new one of ultrasonic type.

4) Rehabilitation Works for 2 Stations: Escolta and Balete

The contents of rehabilitation works for the above two stations is tentatively outlined as follows.

Main pump

- The existing submergible pumps at the 2 stations will be converted into a gate pump type.
- The gate pumps are to be installed in the existing floodgates with due investigation of their mechanical durability.

Electrical system and generator

- All the existing electrical system including main electrical panels, local panels, cable/wires trays, etc., will be replaced.
- Generator equipment will be repaired including panels.

Automatic trash removal equipment

- A small type automatic trash rake and screen and horizontal/inclined conveyor will be additionally installed, if necessary, based on the technical investigation and analysis in due time.

Water level gauging

- The existing water level gauging will be replaced by new one of ultrasonic type.

(3) Non-Structural Measures

1) Recommendation of Countermeasures for Rapid Urbanization

Urbanization has been progressing in the core area of Metropolitan Manila. Consequently, both the capacities of stormwater retention and infiltration into underground are diminishing, resulting in increased runoff volume. The values of runoff coefficient in the past 35 years have gone up in the core area and it is assumed that runoff coefficient values in drainage basins have increased 15 to 20% for the period (1970s to 2004) in North Manila and 10 to 23% in South Manila, as shown in the following table.

Table S.6.7 Increase of Runoff Ratio by Basins of Drainage Pumping Stations

Drainage Area	Pump Drainage Basin	1970s Runoff Coefficient		1980s-1990s Runoff Coefficient		This Study Runoff Coefficient	% Increase from Original Runoff Coefficient
North	Vitas		→	0.75	→	0.74	
	Binondo-Escolta	0.64	→	0.64	→	0.77	20
	Quiapo	0.63	→	0.63	→	0.73	16
	Aviles	0.60	→	0.60	→	0.70	17
	Valencia	0.59	→	0.59	→	0.68	15
	Balut		→	0.65	→	0.79	
South	Tripa de Gallina	0.56	→	0.60	→	0.62	11
	Libertad	0.64	→	0.64	→	0.75	17
	Balete	0.52	→		→	0.64	23
	Paco	0.64	→	0.64	→	0.71	10
	Pandacan	0.68	→	0.68	→	0.63	
	San Andres		→	0.72	→	0.72	0
	Sta. Clara	0.56	→	0.56	→	0.63	13
	Makati	0.62	→	0.62	→	0.68	10

It is recommended that some countermeasures be studied. As one of the options, construction of stormwater retention facilities may be considered in combination with urban development plans under the related LGUs.

2) Rainfall and Water Stage Observation Network in the Core Area

There is only one rainfall station at Port Area, while water levels are recorded at the 15 drainage pumping stations. However, there is no water level gauge along major esteros.

It is important to observe rainfall and water level data as basic hydrological data for hydrological and hydraulic analysis such as rainfall patterns, total amounts, intensities, flow conditions of channels, etc.

In order to supplement such limited data, installation of rainfall stations and water level gauges is proposed. Accumulated rainfall and water level data will contribute to future effective operation of the drainage channels and drainage pumping stations. Installation of three rainfall stations is proposed at Vitas, Paco, Libertad pumping stations. Fifteen (15) staff gauges are proposed to be set along major esteros.

6.3 O & M

(1) General

In order to support and sustain recovered drainage system in the core area of Metropolitan Manila, strengthening of O & M system is required. It is proposed to set up an overall O & M system with the following principle.

- Establishment of a coordination committee consisting of the related agencies: MMDA, LGUs and DPWH.
- Establishment of routine activities for an overall drainage system: drainage channels, pumping stations and solid wastes.
- Establishment of community-involved O & M activities: solid waste management, control of illegal social activities.

(2) Organization

Under the flood control management service of MMDA, two major operations: Pumping Station and Floodgates Operation (PSFO) and Drainage and Waterways Operation (DWO) have O & M activities for the drainage facilities.

PSFO manages the pumping stations operation and garbage collection near the pumping stations as direct undertaking works. Structures of the operation organization are divided into four groups of the pumping stations and one maintenance workshop.

DWO manages the activity of dredging, desilting, declogging, repairing and rehabilitation of drainage waterway, and construction of additional drainage inlets/manholes by direct undertaking works. Territory of management area covers 17 LGUs area.

Existing management area is divided into 11 districts. The study area covers only 12% of the territory. The study area is covered by four major districts: North Manila, Central Manila, South Manila and First South Metro Manila.

Reorganization of O & M management may be discussed widely to include the 17 LGUs. For this study, the tentative discussion of management area is restricted to the study area.

Basic concepts discussed are summarized as follows.

- PSFO and DWO are managed by one operation by drainage basins.
- Major 15 pumping stations are divided into 2 divisions by the Pasig River.

- Two pumping stations of Kamanava and West Mangahan are respectively one group (division) because the stations are from the study area
- Outside of the study area is divided into 4 divisions based on the existing territory and the administration boundary of LGUs.

(3) Community-Involved O & M

It is necessary for MMDA and LGUs to involve barangays in monitoring/inspecting the waterways condition and maintaining their normal functions without solid waste dumping.

The barangay community participation for solid waste management in the drainage system has been promoted through an experiment at three pilot barangays during the Study. The BEM and Team ESTERO activities are aiming to reduce illegal activities and promote public participation for maintenance of drainage system including the following action:

- Solid Waste Management
- Pollution Control
- Beautification
- Information, Education, and Communication (IEC) campaign

The Study proposes to expand the BEM activities to the barangays located along the drainage channels and innovate a community-involved waterways inspection system, which is composed of Superintendents and inspectors.

The roles of Superintendent are:

- To facilitate the drainage inventory
- To appoint inspectors
- To facilitate and monitor inspectors
- To collect information on waterways condition in collaboration with BEM
- To report the waterways condition of his or her management area to MMDA/LGUs

The roles of inspector are:

- To support the Superintendents in order to improve the drainage inventory
- To prepare the site information through the site inspection
- To keep good liaison with BEM activities

Prior to setting up the waterways inspection system, MMDA/LGUs shall take necessary legal arrangement.

6.4 CONSTRUCTION PLAN AND PROJECT COST

(1) Package and Mode of Bidding

The contract package and bidding mode are proposed as shown in the table below for the priority projects taking into account the type and scale of construction works required and expected finance source.

Table S.6.8 Contract Package and Bidding Mode

Contract Package	Mode of bidding
(1) Rehabilitation and Additional Works for Drainage Channel Facilitiesin North Manila	
1) Estero de Sunog Apog I	LCB
2) Estero de Sunog Apog II	LCB
3) Bluementritt Interceptor	ICB
(2) Rehabilitation and Additional Works for Drainage Channel Facilities in South Manila	
1) Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I	LCB
2) Buendia Outfall	ICB
3) Zobel Roxas Drainage Main	ICB
4) Pasong Tamo Drainage Main	LCB
5) Faraday Drainage Main	ICB
(3) Rehabilitation and Additional Works of Pumping Stations	
1) Group 1(Aviles, Quiapo, Valencia, Tripa de Gallina)	ICB
2) Group 2 (Pandacan, Paco, Libertad, Makati, Binondo)	ICB
3) Group 3 (Balete and Escolta)	ICB

(1) Construction Cost

The construction works are composed of 3 lots and 11 projects. The civil works cost is shown in the following table.

Table S.6.9 Civil Works Cost of Respective Works

Sub Project	Civil Works Cost (million Pesos)	Procurement of Contractor /Equipment
Lot I: Rehabilitation and Additional Works for Drainage Channel Facilities in North Manila		
1. Estero de Sunog Apog I	20.4	LCB
- Dredging	20.4	
2. Estero de Sunog Apog II	166.7	LCB
- Dredging	166.7	
3. Blumentritt Interceptor	563.2	ICB
- Declogging of existing Blumentritt Interceptor	43.6	
- Construction of additional Blumentritt Interceptor	519.6	
4. Sub total	**750.3**	
Lot II: Rehabilitation and Additional Works for Drainage Channel Facilities in South Manila		
1. Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I	87.5	LCB
- Dredging	87.5	
2. Buendia Outfall	43.5	ICB
- Declogging	43.5	
3. Zobel Roxas Drainage Main	54.9	ICB
- Declogging	7.5	
- Construction of additional box culvert	47.4	
4. Pasong Tamo Drainage Main	2.9	LCB
- Declogging	2.9	
5. Faraday Drainage Main	269.3	ICB
- Declogging	0.3	
- Construction of additional box culvert	269.0	
6. Sub total	**458.1**	
Lot III: Rehabilitation and Additional Works of Pumping Stations		
1. Rehabilitation of 12 Pumping Stations	2,005.0	ICB
- Group 1 (Aviles,Quiapo,Valencia,Tripa de Gallina)	1,057.0	
- Group 2 (Pandacan, Paco, Sta. Clara, Libertad, Makati, Binondo)	880.0	
- Group 3 (Escolta and Balete)	68.0	
2. Sub total	**2,005.0**	
Installation of Equipment and Facilities for Effective O&M Activities	39.1	ICB
1. Emergency O&M equipment	37.6	
2. Rainfall and water level observation facilities	1.5	
3. Sub total	**39.1**	
Grand Total	**3,252.5**	

(2) Other Costs

1) Cost for Resettlement (700 families)

- **Total resettlement cost: Php192.2 million**
- Resettlement cost excluding land acquisition cost: Php164.1 million
- Land acquisition cost for relocation site: Php28.1 million

2) Cost for Compensation for Additional Works

- **Total compensation cost for additional works: Php19.1 million**
- Land acquisition: Php2.3 million
- House compensation: Php16.8 million

3) Cost for Community-Involved Solid Waste Management

- **Total cost for community-involved SWM: Php87.2 million**
- Cost for BEM and Team ESTERO activities: Php63.3 million
- Cost for IEC: Php23.9 million

4) Cost for Installation of Equipment and Facilities for Effective O&M Activities

- **Total cost for installation of equipment and facilities: Php39.1 million**
- Cost for emergency O&M equipment: Php37.6 million
- Cost for additional hydrological equipment: Php1.5 million

Note: The cost is included in civil works cost.

5) Annual O&M cost

- **Annual cost for operation and maintenance activities:Php241.0 million**

(3) Project Cost

The project cost of the priority projects except price contingency is estimated at Php 4,952.0 million as shown in the following table.

Table S.6.10 Project Cost

Item	Amount (million Pesos)	Remarks
1. Civil Works cost	3,415.1	
1.1 Main works	3,252.5	incl. preparatory/temporary cost
1.2 Miscellaneous	162.6	5 % of (1.1)
2. VAT	341.5	10 % of (1)
3. Resettlement and Compensation Cost	221.9	
3.1 Resettlement cost	192.2	
3.2 Compensation cost for additional works	19.1	
3.3 Miscellaneous	10.6	5 % of (3.1+3.2)
4. Government administration cost	102.5	3 % of (1)
5. Engineering services cost	341.5	10 % of (1)
6. Physical contingency	442.3	10 % of (1+2+3+4+5)
7. Supporting measures cost	87.2	
7.1 BEM and Team ESTERO	63.3	
7.2 IEC	23.9	
8. Total project cost	4,952.0	

Note: US$1.0=Php55=JY110 (July 2004)

(4) Construction Schedule

1) Basic Conditions

The basic conditions adopted for formulation of the construction plan and schedule are as follows:

- Annual workable days are assumed at 210 days for earthworks and 260 days for concreting and other works, considering the number of holidays and suspended days due to rainfall in the wet season.
- Working days and hours are set at 25 days per month and 8 hours per day in principle.
- Locally available construction resources are to be used as much as practicable. The following information is determined by the survey on local construction conditions:
  - Skilled and unskilled labors are available in the Philippines,
  - The backfill materials are to be purchased,
  - A ready mixed concrete factory of 40 m^3/hr production capacity is available,

- Construction equipment rental is available in the Philippines, and
- Other construction materials such as cement, reinforcing bar, and concrete aggregates are available.

- Transportation conditions should be carefully studied to decide the construction plan.
- Public electrical power is available at all construction sites.
- Water required for construction is also available.
- Construction works are assumed to be executed by competitive bidding.

2) Construction Plan and Schedule

The construction schedule is shown in *Figure S.6.2*. It is recommended that construction be jumpstarted at a very small portion of lower Estero de Sunog Apog in 2005 for the smooth commencement of all the drainage improvement works. Some dredging (clearing) works and most of declogging works can be commenced after completion of the Feasibility Study prior to the detailed design of the major works.

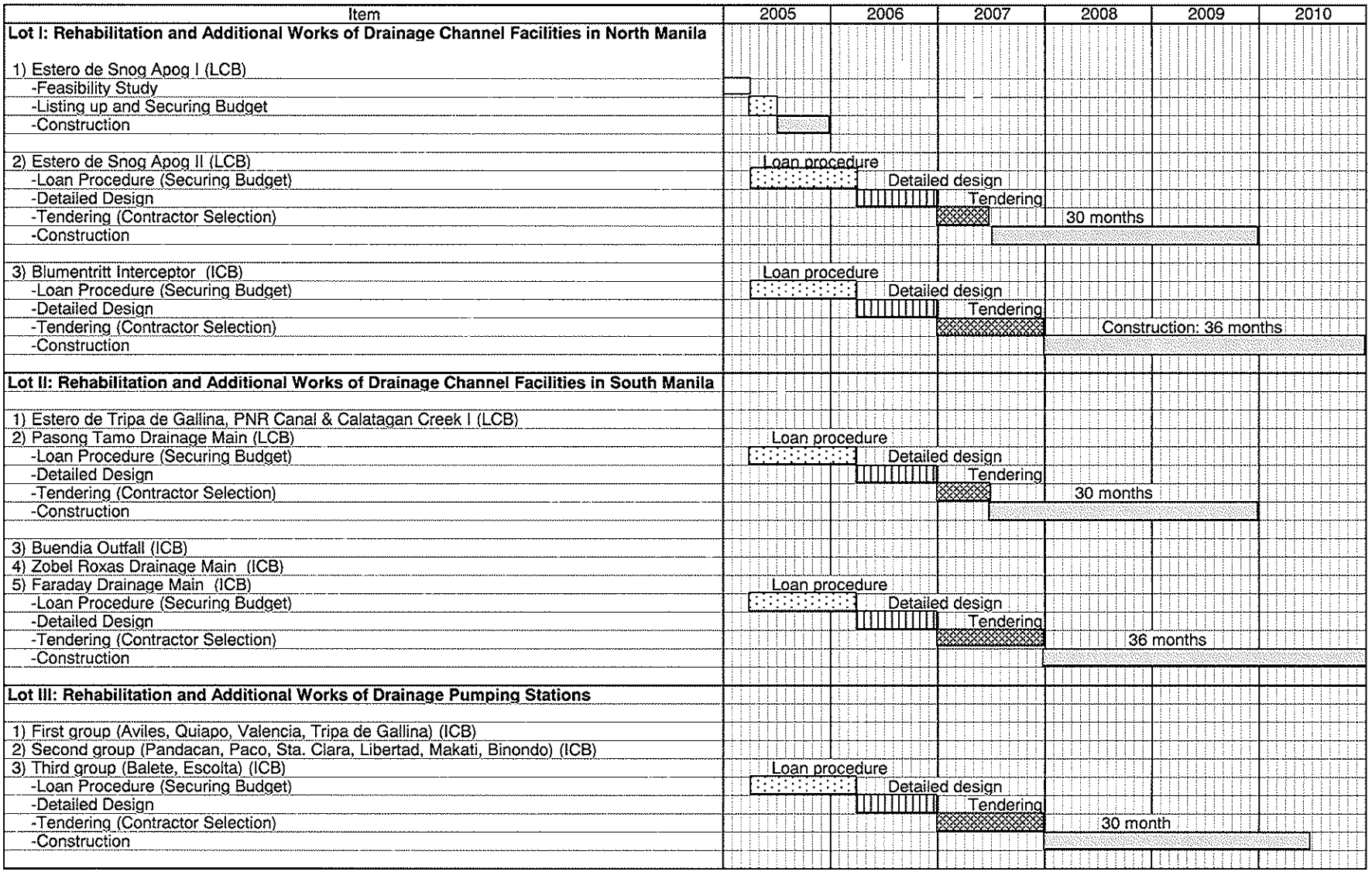


Figure S.6.2 Construction Time Schedule

6.5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

During EIA study, the following are carried out:

Table S.6.11 Study Process of EIA

	Participants and Activities
First Level Scoping Session November 11, 2004	Participants: Representative of EMB, IEE/EIA Review Committee, DPWH, EIA Consultants, JICA Study Team
Second Level Scoping Session and Stakeholders Consultation for North Manila November 28, 2004	Participants: Municipal and barangay officials, representative from the project affected people, government agencies, DPWH, EIS Consultants, JICA Study Team
Second Level Scoping Session and Stakeholders Consultation for South Manila November 28, 2004	Participants: Municipal and barangay officials, representative from the project affected people, government agencies, DPWH, EIS Consultants, JICA Study Team
Project Site investigation by EMB and member of the EIS Review Committee November 29, 2004	Participants: Member of EMB staff, EIA Review Committee, DPWH, EIA Consultants, JICA Study Team
Primary Data Collection	1) Water quality survey (January 2005) 2) Bottom sediment quality survey (January 2005) 3) Ambient air quality survey (December 2004) 4) Traffic volume survey (December 2004) 5) Perception survey (December 2004 – January 2005)
Secondary data collection	For this EIS, secondary data were gathered from sources available from various government agencies, libraries, professional and academic papers and related literature from the cities of Makati, Pasay, Caloocan, Manila and Quezon.
Social Development Planning Workshop January 15, 2005	Participants: Barangay Officials, Community leaders, Multi-sectoral Representatives, LGUs Department Heads, Identified relocatee's representatives from Barangay Palanan and San Isidro in Makati City, and Barangay 43, 46, 51 and 54 in Pasay City, National Inter-Agency Representatives (TLRC and NHA)

The impact matrices for the proposed projects are prepared in the EIA study. Results of the assessment showed that some of the impacts especially during construction stage are negative but manageable.

6.6 PROJECT EVALUATION

(1) Economic Evaluation

1) Benefit of the Project

The components of benefit considered in the Feasibility Study are selected as same as analysis of the Master Plan. Correspondingly, same unit values of assets, parameters of damage rate, future socio-economic framework and so on are applied in the Feasibility Study.

Flood damage under the "Without" situation, the same estimate as the Master Plan. The results of the estimates under the "With Feasibility Study Project" are summarized in the following tables:

Table S.6.12 Flood Damage by Return Period (With Priority Projects: North Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	5,011.0	5,869.9	7,274.5	8,938.9	11,595.2	13,033.3
1. Residence - House	757.8	901.0	1,054.6	1,253.1	1,833.0	2,113.2
2. Residence - Household Effects	352.9	456.9	589.1	724.7	993.0	1,156.3
3. Business Establishments	2,712.0	3,120.1	3,905.8	4,841.4	6,019.7	6,673.2
3-1 Manufacturing	775.8	898.4	1,129.0	1,403.4	1,740.2	1,925.9
3-2 Commerce (Wholesale & Retail Trade)	772.6	900.1	1,142.7	1,430.1	1,809.2	2,028.1
3-3 Hotel and Restaurants	409.0	467.7	581.7	716.6	876.3	962.8
3-4 Financial / Insurance / Real Estate Business	351.3	400.5	497.6	613.0	757.0	836.0
3-5 Educational Facilities	98.4	110.3	134.3	164.0	202.1	221.7
3-6 Medical Facilities	305.0	343.2	420.4	514.3	635.0	698.7
4. Infrastructure	1,188.3	1,391.9	1,725.0	2,119.7	2,749.5	3,090.6
B. Indirect Damage	2,373.6	2,828.1	3,510.4	4,303.9	5,630.6	6,331.9
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	1,521.4	1,768.6	2,201.9	2,716.5	3,458.2	3,863.7
6. Cost for Alternative Activities	852.2	1,059.6	1,308.5	1,587.4	2,172.4	2,468.2
C. Total	7,384.7	8,698.0	10,784.9	13,242.8	17,225.7	19,365.2

Source: The Study Team

Table S.6.13 Flood Damage by Return Period (With Priority Projects: South Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	1,990.2	3,534.4	5,568.0	8,869.7	11,308.4	12,582.9
1. Residence - House	303.6	690.6	1,173.9	2,039.1	2,625.1	2,882.9
2. Residence - Household Effects	142.4	327.9	552.8	1,044.3	1,434.2	1,606.9
3. Business Establishments	1,072.2	1,677.8	2,521.0	3,683.0	4,567.6	5,109.3
3-1 Manufacturing	257.5	395.9	599.6	873.3	1,065.0	1,197.2
3-2 Commerce (Wholesale & Retail Trade)	297.5	464.0	700.0	1,036.8	1,306.9	1,480.6
3-3 Hotel and Restaurants	183.7	294.7	440.7	634.3	780.8	867.2
3-4 Financial / Insurance / Real Estate Business	177.7	280.8	417.9	616.7	780.0	862.0
3-5 Educational Facilities	36.4	56.4	84.6	121.2	146.2	161.5
3-6 Medical Facilities	119.3	185.9	278.2	400.8	488.7	540.8
4. Infrastructure	471.9	838.1	1,320.3	2,103.3	2,681.6	2,983.8
B. Indirect Damage	908.5	1,637.6	2,584.5	4,268.6	5,458.0	6,052.5
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	602.3	1,013.2	1,566.0	2,412.5	3,044.2	3,393.8
6. Cost for Alternative Activities	306.2	624.4	1,018.5	1,856.1	2,413.8	2,658.6
C. Total	2,898.6	5,172.1	8,152.5	13,138.3	16,766.4	18,635.3

Source: The Study Team

Table S.6.14 Flood Damage by Return Period (With Priority Projects: All Study Area)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	7,001.2	9,404.4	12,842.5	17,808.6	22,903.6	25,616.2
1. Residence - House	1,061.4	1,591.6	2,228.6	3,292.2	4,458.1	4,996.1
2. Residence - Household Effects	495.3	784.8	1,141.9	1,769.0	2,427.1	2,763.2
3. Business Establishments	3,784.3	4,797.9	6,426.7	8,524.5	10,587.3	11,782.5
3-1 Manufacturing	1,033.3	1,294.2	1,728.7	2,276.7	2,805.2	3,123.1
3-2 Commerce (Wholesale & Retail Trade)	1,070.1	1,364.2	1,842.7	2,466.9	3,116.1	3,508.7
3-3 Hotel and Restaurants	592.7	762.5	1,022.4	1,350.9	1,657.1	1,830.0
3-4 Financial / Insurance / Real Estate Business	529.0	681.3	915.4	1,229.7	1,537.0	1,698.0
3-5 Educational Facilities	134.8	166.7	218.9	285.2	348.2	383.2
3-6 Medical Facilities	424.3	529.1	698.6	915.1	1,123.7	1,239.5
4. Infrastructure	1,660.2	2,230.0	3,045.3	4,222.9	5,431.1	6,074.3
B. Indirect Damage	3,282.1	4,465.7	6,094.9	8,572.4	11,088.6	12,384.4
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	2,123.7	2,781.8	3,767.9	5,129.0	6,502.4	7,257.5
6. Cost for Alternative Activities	1,158.3	1,684.0	2,327.0	3,443.4	4,586.2	5,126.8
C. Total	10,283.3	13,870.1	18,937.4	26,381.1	33,992.2	38,000.6

Source: The Study Team

2) Cost of the Priority Projects

All financial costs are converted into economic cost by categorizing foreign currency portion and local currency portion. In the analysis of Master Plan, only general two types of share rates of foreign currency portion and local currency portion are used, but in this feasibility study analysis, every project items were identified each distribution of foreign and local currency individually.

3) Operations and Maintenance (O/M) Costs

Cost for operation and maintenance are assumed as same condition as Master Plan Analysis. Operation cost is included for 2005-2010. after project implementation period (2011) are excluded from economic analysis except for the additional maintenance cost to maintain the engineering capacity of the drainage system increased by the additional works proposed as priority projects. Maintenance cost is considered for 2005-2040.

And also, the project costs for supporting measures were excluded from this economic analysis. .

Table S.6.15 Project Cost (Priority Projects)

Work Item	North Manila		South Manila		All Study Area	
	F/C	E/C	F/C	E/C	F/C	E/C
Civil Works	1,685.7	1,627.9	1,729.0	1,685.1	3,415.1	3,313.0
VAT	168.5	0.0	172.9	0.0	341.5	0.0
Resettlement & Compensation	17.8	15.3	204.0	175.4	221.9	190.8
Government Administration	50.6	48.8	51.9	50.6	102.5	99.4
Engineering Services	168.5	162.8	172.9	168.5	341.5	331.3
Physical Contingency	209.1	185.5	233.1	208.0	442.3	393.4
Operation	0.0	649.8	0.0	593.8	0.0	1,243.6
Maintenance	0.0	256.7	0.0	266.1	0.0	522.8
Total	2,300.0	2,946.8	2,564.1	3,147.5	4,864.8	6,094.3

Note : F/C= Financial Cost, E/C= Economic Cost. Cost for Supporting Measures are excluded. Details may not add up to totals due to rounding./ Source: The Study Team

4) Economic Viability

The Priority Projects are evaluated from the economic viewpoint by figuring out the economic viability, comparing the economic benefit and the economic cost in terms of economic internal rate of return (EIRR), benefit/cost ratio (B/C), and net present value (NPV or B – C, i.e. Benefit minus Cost).

All the monetary calculations are based on the following parameters either predetermined or using assumptions.

Project Duration (Economic Life)

- Civil works and collateral works & arrangements for the Priority Projects start in 2005 and complete in 2010.
  Then, beyond 2010, operation and maintenance works continue for 30 years.
  i.e.
  2005 – 2010 (6 years) : Civil works and collateral works & arrangements including structural and non-structural measures
  2011 – 2040 (30 years) : Operation & maintenance as supporting measures

Timing of Accruing Benefits

The timing of accruing flood reduction benefit is set as follows:

- 50% of annual average benefit will appear after 2011
- 75% of annual average benefit appear after 2016
- The matured average benefit will appear after 2021

Price Level

- The valuation of project costs and benefit should be in constant price at the current year's level. Though, cost of civil works was identified as the price at July 2004, the basic price level in the economic analysis is set at the beginning of 2004 in order to keep consistency among all cost items.

Social Discount Rate (SDR)

- SDR is applied at 15% based on the guideline of NEDA for basic infrastructure projects as same as the analysis of Master Plan.

Prevailing Exchange Rate

- Php55 per US$ and JPY110 per US$ at the official rate in market as same as the analysis of Master Plan

Depreciation, Financial Charges, Interest and Amortization

- In general, financing of the project is not relevant to the economic evaluation. From these points of view, depreciation (residual value) of waterways and pumping stations, and financial cost or charges are not estimated in the economic evaluation.

The calculations of NPV, B/C, and EIRR are based on the annual cash flow that is prepared from the above-mentioned economic cost and the annual average benefit discussed in accordance with the implementation schedule or annual disbursement schedule. The economic viability of the priority projects was thus figured out as follows.

Table S.6.16 Results of Economic Analysis (Future Condition, Priority Projects)

	North Manila	South Manila	All Study Area
NPV	Php 4,817 mil.	Php 7,374 mil.	Php 12,191 mil.
B/C	3.7	4.8	4.3
EIRR	34.0 %	38.8 %	36.6 %

Source: The Study Team

5) Sensitivity Analysis

The cost and benefits are estimated at conservative side with discretion in this analysis. In spite of that, some uncertainty still exists in the estimation. In particular, the cases with long implementation period and/or expectation of future growth in Metropolitan Manila have high risks in terms of judgment on project viability. In this context, the sensitivity analysis is tested in the following relevant parameters guided by NEDA in consideration of sensitive factors for project feasibility.

Assumption I: Increase in projected costs by 10% and 20%

Assumption II : Decrease in revenues by 10% and 20%

Assumption III : Combination of Cases I and II

In addition to the above NEDA assumptions, another case that the benefit decreased to 50% of

original estimate was also tested for reference. i.e.,

Assumption IV : Decrease in revenues by 50%

The results are as follows:

Table S.6.17 Results of the Sensitivity Analysis 1 (NPV, Future Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	12,191	10,601	9,012	4,243
	+10%	11,821	10,231	8,641	3,872
	+20%	11,450	9,860	8,271	3,501

Source: The Study Team

Table S.6.18 Results of the Sensitivity Analysis 2 (B/C, Future Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	4.3	3.9	3.4	2.1
	+10%	3.9	3.5	3.1	1.9
	+20%	3.6	3.2	2.9	1.8

Source: The Study Team

Table S.6. 19 Results of the Sensitivity Analysis 3 (EIRR, Future Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	36.6%	34.5%	32.3%	24.6%
	+10%	34.7%	32.8%	30.6%	23.2%
	+20%	33.1%	31.2%	29.1%	22.0%

Source: The Study Team

(2) Project Evaluation

1) Technical Aspect

By the implementation of the Master Plan the inundation conditions in the core area will be improved as a whole, but by the implementation of the Priority Projects the inundation conditions in the severest inundation areas in both North Manila and South Manila will be improved.

Though 87,000 houses and a half of the roads (1,389 km) were affected in the 1999 floods and the flood and inundation affecting population numbers and road networks will be significantly reduced in the severe inundation area in both North Manila and South Manila by the implementation of the priority projects due to the reduction of the flood and inundation depth and duration.

The proposed drainage improvement measures are all basic and conventional ones and will be maintained by the implementation agencies and the proposed improvement of O & M system

could be effective for the management of drainage system.

And the database developed for the Study and transferred to the implementation agencies will support in improving the O & M activities for drainage facilities, and also the promotion of the barangay-involved community activities will improve and sustain the drainage facilities by reducing illegal activities at the barangay level.

2) Economic and Financial Aspect

Basic social infrastructure projects such as flood control and drainage improvement works shall be implemented in general even at the lower EIRR, compared with other productive projects.

The Priority Projects show a high viability of 36.6% in EIRR (Future Conditions), a higher value of EIRR than the 15%, which is the NEDA guideline for basic infrastructure projects, likewise resulting in high values of B/C (4.3) and NPV (Php12,191 million) for the conceivable reason that socio-economic needs for prevention of the flood and inundation in the core area, where has the central function of the political and economic activity in the country.

3) Financial Aspect

When the annualized cost of proposed cost of the priority projects are compared to the average amount of total expenditure of MMDA and 6 LGUs for the past 6 years, it is fairly huge and requires almost 1.2 times of annual budget of relevant agencies in order to implement the project.

While, on the assumption when some portion of Priority Projects would be financed by ODA loan or other assistance scheme, the burden of the agencies would be eased. If the costs for civil works which is equivalent to around 70% of total propose costs of Priority Projects are financed by assistance scheme, the share of the agencies would become 35% of total expenditure of relevant agencies and it is not a prohibitive level from the aspect of the financial status of the authorities.

The project involves various non structural and supporting activities, which are fundamental measure for the drainage improvement and shall be conducted by the local budget, but the measure works of improvement and rehabilitation for the drainage facilities would require the financial assistance by grant or loan for implementation.

4) Social and Environmental Aspect

Major issues related to social/environmental aspects of the project are as follows:

- The rehabilitation of the drainage channels proposed in the Master Plan requires relocating informal settlers occupying inside drainage channels: about 5,500 families estimated for the master Plan and 700 families counted for the Priority Projects, respectively. An optimum resettlement action plan for the people shall be prepared according to the guidelines for resettlement action plan prepared in the Study in order to avoid any adverse social impacts. One resettlement site at the city of Rodriguez is proposed for the Priority Projects.
- The rehabilitation works also require dredging of a huge volume of bottom garbage/sediment, which was estimated to be 920,000 m^3 and 150,000 m^3 for the Master Plan and the Priority Projects respectively. The disposal site shall be prepared for the dredged materials and one disposal site at Malabon is proposed for the Priority Projects.
- The various social adverse impacts caused by habitual flood and inundation will be reduced by the implementation of priority projects, reducing the flood and inundation conditions

(flood/inundation depth and duration).

- The impact matrices for the proposed projects are prepared in the EIA study. Results of the assessment showed that some of the impacts especially during construction stage are negative but manageable.

6.7 RESETTLEMENT

(1) Resettlement Action Plan Guideline

The Action Plan may include, at least, the following items and contents.

- Rationale and Objectives
- Project Description that Includes its Scope and Schedule
- Scale and Types of Impacts
- Legal Bases
- Resettlement Site
- Socio-Economic Profile of the Affected Families and Communities
- Setting of Cut-Off Date
- Compensation
- Demolition Date
- Public Consultation and Hearing
- Options for Resettlement Assistance
- Post-Relocation Assistance for Reconstruction of Livelihood
- Provision of Social services
- Grievance and Complaints
- Monitoring
- Funds sources

(2) Considerations Required

Particular considerations required for preparation of the Resettlement Action Plan are as follows:

In order to have a clear picture of the Plan, first requirements are to draw:

- A flow chart of the resettlement operation plan by step of tasks
- A matrix to explain what section of responsible organization(s) will work on each component/step/task and how many staffs shall be assigned
- What kinds of groups shall be organized at the barangay level and the government level to assist the PAFs on resettlement such as Task Force, Inter-Agency Committee, Monitoring Team, etc. and their duties.

(3) Preparation of the Plan

1) Acquisition of Resettlement Site and Preparation of Resettlement Site

- Plan for Land Acquisition
- Description of the Site and Surrounding Environment
- Plan for Site Development and Basic Infrastructure
- Plan for Preparation of Socialized Housing

- Acceptance by the PAPs
- Acceptance by the Recipient Community

2) Socio-Economic Profiles of Project Affected Families and Communities

- Overall Existing Conditions of PAFs and Communities
- Analyses of the Above Findings

7. IMPLEMENTATION PROGRAM

7.1 IMPLEMENTATION AGENCY

The drainage facilities and solid waste management in the core area of Metropolitan Manila are now under the responsibility of MMDA and LGUs; however, the implementation of the proposed Master Plan and Priority Projects would require the involvement of many agencies including DPWH, MMDA, NHA, LGUs and others in order to carry out the drainage improvement project. A good coordination among them is also essential.

It is necessary to decide an implementing agency for the implementation of projects and to establish a coordination committee for smooth implementation of the Master Plan and Priority Projects.

It is proposed that DPWH coordinate the related government organizations as the main implementing agency for the Study, in order to attain the aim of drainage improvement in the core area of Metropolitan Manila.

7.2 IMPLEMENTATION SCHEDULE

The target year of the Priority Projects is 2010. The implementation and the disbursement schedules are shown in *Figure S.7.1* and *Table S.7.1*.

The construction works consist of rehabilitation of drainage channels, rehabilitation of drainage pumping stations, additional works for drainage channels and additional works for drainage pumping stations in the core area. It is assumed that the detailed designs and construction and rehabilitation works proposed for the priority projects and the related resettlement plan will be executed by local and international competitive bidding basis or supported by the JICA technical cooperation program as suggested by DPWH.

The detailed design including tendering procedure will be conducted from 2006 to 2007 and the construction works will be conducted from 2008 to 2010, except the LCB which will be conducted from the mid 2007 to 2009.

The construction works are planned to be composed of 3 lots with 11 packages, which will be carried out by contractors selected through local competitive biding (LCB) and/or international competitive biddings (ICB) as follows:

Rehabilitation and Additional Works of Drainage Channel Facilities in North Manila (Lot I)

- Estero de Sunog Apog I (lower part): LCB
- Estero de Sunog Apog II (remained part): LCB
- Blumentritt Interceptor: ICB

Rehabilitation and Additional Works of Drainage Channel Facilities in South Manila (Lot II)

- Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I: LCB
- Buendia Outfall: ICB
- Zobel Roxas Drainage Main: ICB
- Pasong Tamo Drainage Main: LCB
- Faraday Drainage Main: ICB

Rehabilitation and Additional Works of Drainage Pumping Stations (Lot III)

- First group (Aviles, Quiapo, Valencia and Tripa de Gallina): ICB
- Second group (Pandacan, Paco, Sta. Clara, Libertad, Makati and Binondo): ICB
-Third group (Balete, Escolta): ICB

It is assumed that the soft components are to be commenced and conducted as soon as possible by the respective agencies of MMDA and LGUs. The proposed soft components are as follows:

- Barangay-involved Solid Waste Management
- Improvement of Operation and Maintenance Organization and Activities
- Installation of Equipment and Facilities for Effective Operation and Maintenance

As for the relocation of the informal settlers in the objective channel of Estero de Tripe de Gallina a Resettlement Action Plan should be prepared and carried out by the implementation agency in collaboration with the respective LGUs. The relocation or resettlement should be carried out in advance of the rehabilitation works for the Estero de Tripe de Gallina.

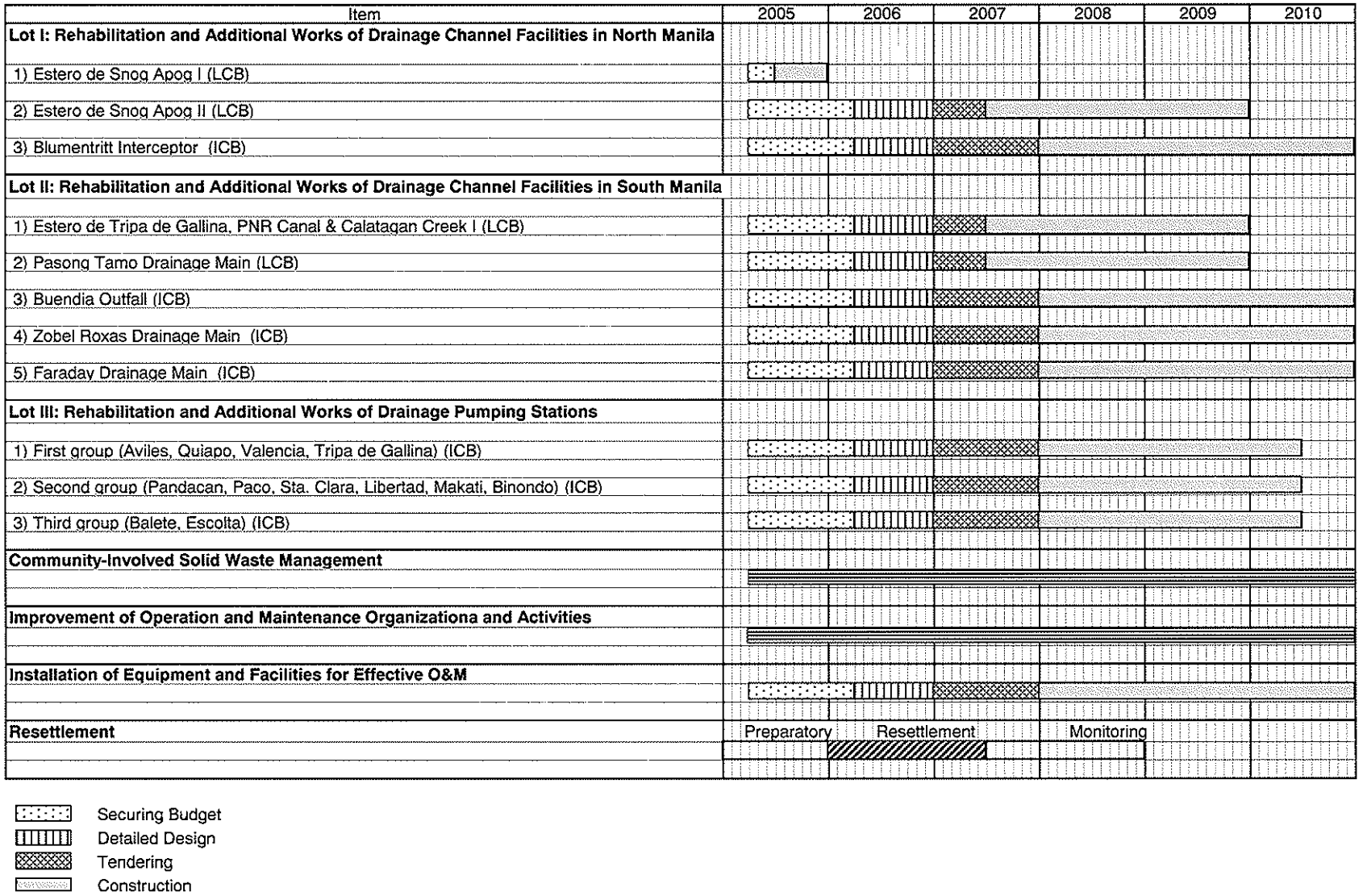


Figure S.7.1 Implementation Schedule of the Priority Projects

Table S.7.1 Disbursement Schedule of the Priority Projects

Unit: Million Peso

Work Item	Project Cost	Year						Total
		2005	2006	2007	2008	2009	2010	
Civil Works	3,415.1	21.4	0.0	53.9	2209.6	629.0	501.2	3,415.1
1) Main	3,252.5	20.4	0.0	51.3	2104.4	599.1	477.3	3,252.5
- Rehabilitation and Additional Works for Drainage Channel facilities in North Manila	750.3	20.4	0	33.3	254.5	254.4	187.7	750.3
a) Estero de Sunog Apog I	20.4	20.4	0	0	0	0	0	20.4
b) Estero de Sunog Apog II	166.7	0	0	33.3	66.7	66.7	0	166.7
c) Blumentritt Interceptor	563.2	0	0	0	187.8	187.7	187.7	563.2
- Rehabilitation and Additional Works for Drainage Channel facilities in South Manila	458.1	0	0	18	158.8	158.8	122.5	458.1
a) Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I	87.5	0	0	17.5	35	35		87.5
b) Buendia Outfall	43.5	0	0	0	14.5	14.5	14.5	43.5
c) Zobel Roxas Drainage Main	54.9	0	0	0	18.3	18.3	18.3	54.9
d) Pasong Tamo Drainage Main	2.9	0	0	0.5	1.2	1.2		2.9
e) Faraday Drainage Main	269.3	0	0	0	89.8	89.8	89.7	269.3
- Rehabilitation of Pumping Station	2,005.0	0	0	0	1671	167.1	167.1	2,005.0
a) Group 1	1,057.0	0	0	0	880.8	88.1	88.1	1,057.0
b) Group 2	880.0	0	0	0	733.4	73.3	73.3	880.0
c) Group 3	68.0	0	0	0	56.6	5.7	5.7	68.0
- Installation of Equipment and Facilities	39.1	0	0	0	20.3	18.8	0.0	39.1
2) Miscellaneous	162.6	1	0	2.6	105.2	29.9	23.9	162.6
VAT	341.5	2.1	0.0	5.4	221.0	62.9	50.1	341.5
Resettlement and Compensation Cost	221.9	0	134.5	87.4	0	0	0	221.9
1) Resettlement Cost	192.2	0	128.1	64.1	0	0	0	192.2
2) Compensation cost for additional works	19.1	0	0	19.1	0	0	0	19.1
3) Miscellaneous	10.6	0	6.4	4.2	0	0	0	10.6
Government Administration Cost	102.5	0.6	0	1.6	66.3	18.9	15.1	102.5
Engineering Services	341.5	2.1	0	5.4	221	62.9	50.1	341.5
Physical Contingency	442.3	2.6	13.5	15.4	271.7	77.4	61.7	442.3
Sub-Total		28.8	148.0	169.1	2989.6	851.1	678.2	4,864.8
Supporting Measure Cost	87.2	8.2	9.6	12.4	16.7	18.6	21.7	87.2
1) BEM and Team ESTERO	63.3	3.4	5.9	8.7	12	15.1	18.2	63.3
2) IEC	23.9	4.8	3.7	3.7	4.7	3.5	3.5	23.9
Total		37.0	157.6	181.5	3006.3	869.7	699.9	4,952.0

8. EXPERIMENTAL ACTIVITIES AT BARANGAY

Experimental activities are being conducted in the following barangays selected:

- Manila City : Barangay 195 (Population: 1249)
- Pasay City : Barangay 46 (Population: 4509)
- Makati City : Barangay Palanan (Population: 16,614)

Community activities being conducted for the experiment are as follows:

- Conduct of IEC at barangay level
- Solid waste collection management at barangay level
- Cleaning of drainage channels at barangay level
- Pollution control at barangay level

The results of the experiment show the effectiveness of barangay environmental management by BEM and Team ESTERO activities. The barangay people that participated in the experiment mostly have a positive attitude towards the process experienced in the experimental activities and the promotion of community-involved solid waste collection management and maintenance of drainage channels.

9. CONCLUSION AND RECOMMENDATION

The proposed Master Plan and Priority Projects for the core area are effective in terms of technical, economic, social and environmental aspects for drainage improvement in the core area. By the implementation of the proposed drainage improvement plan, the severe inundation area will significantly be reduced and improved. It is recommended for the Government of the Philippines to take immediate actions for the implementation of the proposed measures, because the core area of Metropolitan Manila is very important economically and socially in the country, but extremely vulnerable to flood and inundation problems. The Study recommends the actions as follows.

(1) The rehabilitation of the existing major drainage facilities: drainage channels and drainage pumping stations, shall be conducted according to the proposed schedule in order to prevent/mitigate the damages caused by floods and inundation in the core area of Metropolitan Manila. The Priority Projects identified in the Master Plan shall require immediate actions, and be conducted duly according to the schedule.

(2) The relocation of informal settlers living inside the target drainage channels (esteros/creeks) shall be conducted before dredging. The implementing agencies shall select resettlement sites and prepare a "Resettlement Action Plan" for the Priority Projects and the Master Plan through a series of public consultation, based on the resettlement guideline prepared in the Study and the JICA guideline for environmental and social awareness, and shall avoid executing any summary evictions and returnees. Although there are some structures encroaching partly the drainage channel, the detailed number of project affected people for relocation or structure for compensation shall be decided based on the detailed design.

(3) The O & M organizations shall be improved and barangay-involved O & M system shall be established, and those organizations shall conduct not only proper O & M activities for drainage facilities but also carry the responsibility for proper solid waste collection management at the barangay level to avoid illegal activities for sustaining the capacity of the drainage facilities after the rehabilitation/improvement of drainage channels.

(4) The major drainage pumping stations require detailed rehabilitation programs through overhauling and the 12 drainage pumping stations require rehabilitation, but the 4 drainage pumping stations: Quiapo, Aviles, Valencia and Tripe de Gallina, are in a critical conditions requiring immediate actions for rehabilitation.

(5) The implementing agency shall be decided and organize a coordination committee for the implementation of the Master Plan and Priority Projects, because the implementation of the Master Plan and Priority Projects shall require various concerned central and local government agencies and stakeholders.

(6) The barangay environmental management shall be extended to other barangays along esteros/creeks to promote the community participation for improvement of various barangay activities including improvement/sustainment of the drainage capacity. The BEM (Barangay Environmental Manager) and Team ESTERO (Environmental Strategic Task for Estero Renewal Organization) activities conducted at three pilot barangays (Manila: Barangay 195, Pasay: Barangay 46, Makati: Barangay Palanan) as an experiment, would be an effective way for enhancement of public awareness through public education, for promotion of public participation for solid waste collection management as well as for prevention against illegal activities like dumping solid waste into drainage channels and

informal settlement in public spaces.

(7) The database for the Study, which has been developed and transferred to the implementing agency and concerned organizations (DPWH, MMDA and LGUs), shall be utilized and updated periodically for the O & M of drainage facilities and the coordinated activities shall be required among the concerned agencies.

(8) DPWH as the implementing agency shall take the initiative to continue the preparation for the implementation of Priority Projects as follows:

- Preparation of the Environmental Impact Statement (EIS) based on the Environmental Impact Assessment (EIA) prepared in the Study and get an Environmental Compliance Certificate (ECC) for Priority Projects
- Preparation of a Resettlement Action Plan (RAP) shall be conducted according to the proposed guideline of social awareness and resettlement, with enough consideration of necessary social and basic infrastructures.
- Preparation of Implementation Program (IP) for financial arrangement shall include necessary measures for drainage improvement of the core area of Metropolitan Manila and also necessary measures required for the resettlement plan.
- Preparation for resettlement sites for the Phases 2 and 3 in the Master Plan shall be conducted according to the proposed relocation schedule of project affected people along the drainage channels.
- Preparation for countermeasures for rapid urbanization to lower runoff coefficient shall be conducted in order to establish sustainable drainage system.